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Static Footprint Local Forces, Areas, and Aspect Ratios for Three Type VII Aircraft Tires

William E. Howell
and Sharon E. Tanner
Langley Research Center
Hampton, Virginia

William A. Vogler
Lockheed Engineering & Sciences Company
Hampton, Virginia

National Aeronautics and
Space Administration
Office of Management
Scientific and Technical
Information Division

Summary

The National Tire Modeling Program is a joint NASA-industry effort to improve the understanding of tire mechanics and to develop accurate analytical design tools. This effort includes fundamental analytical and experimental research on the structural mechanics of tires. As an integral part of this program, footprint local forces, areas, and aspect ratios were measured. Local footprint forces in the vertical, lateral, and drag directions were measured with a special footprint force transducer. Measurements of the local forces in the footprint were obtained by positioning the transducer at specified locations within the footprint and externally loading the tires. The footprint areas and aspect ratios were measured from tire footprints at various inflation pressures and vertical loads. The results are presented in graphical and tabulated forms. Three tires were tested: (1) one representative of those used on the main landing gear of Boeing 737 and McDonnell Douglas DC-9 commercial transport airplanes, (2) a nose landing gear tire for the Space Shuttle orbiter, and (3) a main landing gear tire for the Space Shuttle orbiter. Detailed vertical, lateral, and drag force data for various inflation pressures and vertical loads are presented for the commercial airplane tire and the Space Shuttle orbiter noise gear tire.

Introduction

The U.S. tire industry and NASA are involved in a program to develop analytical tools for tire design. Langley Research Center has a major role in this National Tire Modeling Program (ref. 1). The scope of the program consists of conducting experimental tests to determine the mechanical properties of tire materials, developing techniques to measure tire deformations and tire footprint forces, and developing analytical tools for predicting tire response. The research endeavor will build upon initial efforts to define tire deformations and structural behavior reported in references 2–9. These references are representative of current knowledge on cord-rubber material properties and pneumatic tire dynamic behavior; however, information on the forces developed in a statically loaded tire footprint is extremely limited.

The purpose of this paper is to present selected preliminary results of tire footprint local force distributions that were obtained for a 40 × 14, type VII, 28-ply rated aircraft tire similar to that used on a Boeing 737 or McDonnell Douglas DC-9 transport and a 32 × 8.8, type VII, 28-ply rated tire, which is the Space Shuttle orbiter noise gear tire size. Footprint areas and aspect ratios were obtained for these two tires as well as for a 44.5 × 16, type VII, 34-ply rated aircraft tire, which is the Space Shuttle orbiter main gear tire size. Data were obtained for several tire inflation pressures and vertical loads. The inflation pressures and vertical loads used were within the maximum allowable values for each specific tire. A matrix of the test data is given in table I. The local vertical, lateral, and drag forces that were measured at several discrete locations within the tire footprints are presented in graphical form for the various inflation pressures and vertical loads. In addition to the data presented in this paper, data were obtained at 2000-lb intervals, up to 30 000 lb, and are available upon request.

Apparatus

Footprint Force Transducer

In order to determine the forces developed at the tire-pavement interface, an instrument was designed to measure forces at 10 locations in a footprint simultaneously. This instrument is shown in figure 1 with the cover plate removed to show the row of force measuring devices. These devices are structural beams that were strain-gaged to measure forces in the vertical, lateral, and drag directions with a maximum load capability in each direction of 125 lb/in. The face of each beam is 0.50 × 0.50 in. There is a 0.05-in. clearance between the beam face and the cover plate, and each beam is mounted so that the face is flush with the cover plate. The 10 beams are positioned 1.36 in. apart, center to center. The transducer box structure is 15.0 in. wide and the box grid structure is sufficiently stiff to keep the cover plate rigid. Both the cover plate and the face of the beams were machined to a surface finish of at least 125 μin.

Dynamic Test Fixture

The dynamic test fixture was used to test only the 40 × 14 commercial aircraft tire. This fixture, configured to take a tire footprint, is shown in figure 2. A detailed description of the test fixture is presented in reference 7. In figure 3, the rigidly mounted test tire is shown with the footprint force transducer mounted on the test fixture platen. Four loading cables provide a means of applying a pure vertical load with the platen maintained in a level position.

Static Test Fixture

The static test fixture was used to obtain the footprint forces of the Space Shuttle orbiter nose gear tire. The test tire, mounted in the dynamometer, which is configured to take a tire footprint, is shown in figure 4. Two hydraulic cylinders are used to control the drop carriage and apply the desired vertical load to the tire. One side of the drop carriage has rollers mounted in a track that guides the carriage. This arrangement restrains the carriage from moving fore and aft or to either side. A "frictionless" table positioned on the floor below the test tire was used as the tire loading surface.

Carriage Test Fixture

The dynamometer on which the test tires were mounted is described in detail in reference 8. The carriage on which the dynamometer was mounted at the Langley Landing Loads Track is also described therein. This track, at the Langley Aircraft Landing Dynamics Facility, is used to simulate landings and rollout test conditions for tires and/or landing gear. In the investigation reported herein it was used only to obtain Space Shuttle orbiter main gear tire footprint areas (fig. 5). Since the tire was already mounted on this fixture, it was a convenient way to obtain the tire footprints.

Test Procedures

Commercial Airplane Tire

The footprint force transducer was mounted on the dynamic test fixture as shown in figure 3. The transducer was positioned and supported by a platen which, in turn, was supported by cables. Hydraulic cylinders were used to control the platen position and to apply the desired vertical load. A sheet of white paper with attached carbon paper was placed on the transducer surface to obtain a record of the relative position between the tire tread grooves and the load beams. A computer was used to scan the various strain gage outputs and the force data were printed out.

The transducer was initially positioned at the center of the tire footprint and data were recorded for vertical loads ranging from 2000 to 30 000 lb at 2000-lb intervals. The transducer was then moved 0.5 in. toward the front of the footprint and a new data set recorded. This procedure was continued until data for one-half of the footprint length were obtained. The transducer was then moved to a position 0.5 in. behind the center of the footprint, and the procedure described for the forward half of the footprint was repeated to obtain force data for the rear half of the footprint. These data were then used to produce a graphical display of the local footprint forces in the form of contour and three-dimensional plots.

Tire footprints were obtained for the various inflation pressures and vertical loads on thick sheets of white cardboard. The expected footprint areas on the tire tread would be wiped with lightweight oil and graphite powder, the cardboard would be positioned on the platen under the tire, and then the tire would be lowered onto the cardboard to the specified load. This procedure was repeated for the various inflation pressures and external loads.

Space Shuttle Orbiter Tires

Footprint force measurements were made on the 32×8.8 Space Shuttle orbiter nose gear tire by using the static test fixture. Footprint force measurements were made similarly to those described for the 40×14 tire. The rigidity of this test fixture was sufficient to readily control the location of each beam relative to the tire tread grooves. Therefore, no paper with carbon paper was used for these measurements as described for the 40×14 tire. Footprint force measurements were made at three locations spaced 120° apart around the tire circumference.

No footprint force measurements were made on the 44.5×16 Space Shuttle orbiter main gear tire. Only footprint areas and aspect ratios at different vertical loads were obtained for this tire.

Measurement Accuracy

Two measurement systems were used to collect the force data presented in this report. The footprint local forces were measured with the footprint force transducer box and a data system with a reading resolution of 0.05 lb or 0.04 percent of full scale. The tire vertical load was measured using a system of three load cells and a summing load readout system with a reading resolution of 2 lb or 0.01 percent of full scale and a maximum nonlinearity of 14 lb or 0.07 percent of full scale.

The footprint areas were measured using an electronic digitizer and computer for integration. The measurement accuracy of the digitizer in the configuration used is ± 0.001 in.

Results and Discussion

Footprint force data were obtained only for the commercial airplane tire and the Space Shuttle orbiter nose gear tire. Footprint areas were measured for these tires plus the Space Shuttle orbiter main gear tire. All the footprint force data presented graphically herein are also listed in tabular form in the appendix. These tabulated data are presented in matrix form and are arranged in the same order as the measured forces in the footprint. The resulting data format shows the relative force footprint distribution. Photographs of the associated footprints are also included in the appendix.

Commercial Airplane Tire

Force data obtained from the tire footprint force transducer are presented in figures 6 through 10. In figures 6 through 8, data were presented for the various combinations of vertical loads and inflation pressures, starting at 2000 lb vertical load and 140 psi inflation pressure. The maximum vertical load and tire inflation pressure are 30 000 lb and 170 psi, respectively. For each vertical load and pressure combination, individual contour plots are presented for the vertical, lateral, and drag forces. Supplemental zero-force values were included in each data set to clearly define the location of the tread circumferential grooves. The contour intervals for the local vertical forces were set at 10 lb, and the contour intervals for the lateral and drag forces were set at 4 lb. A dashed contour line represents a negative force. The areas of dashed line contours are bounded by a solid line that is the zero-force contour. Ripples in the contours are an artifact of the contour smoothing routine. The graphics package by the National Center for Atmospheric Research, NCAR, (ref. 10) was used to generate the contours, which were smoothed through an array of 380 discrete data points. The contour smoothing program assumes a smooth gradient among the data points provided. The program does not recognize the possibility of a step increase; for example, in actuality there is no load in the groove area of the footprint, but a significant load may exist at the neighboring point on the outer edge of the tread rib. The computer program, however, fares contour lines evenly spaced between the forced zero point in the groove and the first recorded load on the rib.

Also included in figures 6 through 8 are plots of the tire footprint tangential forces obtained by combining the local lateral and drag forces to show the magnitude and direction of the footprint friction forces. The length of each arrow is proportional to the magnitude of the tangential force, and the direction of the arrow denotes the direction of the friction force. The origin of each arrow indicates the location of each data point (beam location). The dashed lines in each tangential force plot denote the extent of the tire tread footprint.

Tire pressure of 140 psi. Plots of the local tire footprint force contours for a vertical load of 2000 lb are presented in figure 6(a). Although the footprint area is small for this loading condition, substantial vertical forces were generated in the center rib. The vertical force contour plot indicates that there are steep force gradients near the groove edges. This is due to rapid transition from peak forces in the region of the rib edges to zero in the grooves. The maximum lateral and drag forces generated in the footprint are about 20 and 6 percent of the maximum vertical force, respectively. The dashed contour lines for the local lateral and drag forces represent negative values. The outermost contour lines associated with the dashed lines represent a force value of zero. Otherwise the outermost contour line represents a force value of 4 lb.

In figure 6(b), plots of the local tire footprint force contours for a vertical load of 16 000 lb are presented. As expected, the increase in vertical loading caused an increase in the size of the footprint area. The vertical forces in the middle of the center rib are only slightly higher than those observed for the 2000-lb loading shown in figure 6(a). The maximum lateral and drag forces, however, have increased and are about 30 and 20 percent of the maximum vertical force, respectively. The distribution of the local frictional forces is more apparent in the plot of the tangential forces. In the center rib these frictional forces are mainly in the fore and aft directions, whereas in the outer ribs the forces are directed laterally toward the center rib. Near the top of the footprint (see arrows), there is an anomaly in the tangential forces. This anomaly may be attributed to a radial mold line in the tire tread. This may be the cause of the asymmetric loading.

The local tire footprint force contours presented in figure 6(c) are for a vertical load of 30 000 lb. The vertical forces in the center rib are rather uniform, and the peak values are not very much greater than those for the smaller vertical loads. The vertical forces in the two ribs adjacent to the center rib are also fairly uniform. The maximum lateral and drag forces generated in the footprint are about 30 percent of the maximum vertical force.

Tire pressure of 155 psi. Local tire footprint force contours for a vertical load of 2000 lb are presented in figure 7(a). The footprint is essentially the same size as that for a tire pressure of 140 psi, and the maximum vertical force measured in the center rib is only 5 lb greater than that shown for the similar loading condition in figure 6. The maximum lateral and drag forces generated in the footprint are about 10 and 15 percent of the vertical forces, respectively.

In figure 7(b), the local tire footprint force contours are for a vertical load of 16 000 lb. The maximum vertical forces in the center rib are only slightly greater than those for a load of 2000 lb. The maximum lateral and drag forces, however, have increased and are about 30 and 20 percent of the maximum vertical force, respectively. The magnitude and direction of these forces are shown in the plot of the tangential forces. As with an inflation pressure of

140 psi, the forces in the center rib are mainly in the fore and aft directions, whereas in the outer ribs the forces are directed laterally toward the tire center.

The local tire footprint force contours presented in figure 7(c) are for a vertical load of 30 000 lb. The vertical forces in the center rib are essentially uniform and are approximately the same as those for external loads of 2000 lb and 16 000 lb. The vertical forces in the two ribs adjacent to the center rib are fairly uniform but not as uniform as those in the center rib. The lateral forces are smallest in the center rib and highest in the outer ribs. Conversely, the drag forces are relatively small in the outer ribs and are highest in the center rib. The maximum lateral and drag forces generated in the footprint are about 30 percent of the maximum vertical force. The directions of the tangental forces are similar to those presented in figure 7(b).

Tire pressure of 170 psi. In figure 8(a) the local tire footprint force contours are presented for a vertical load of 2000 lb. As expected, the footprint is slightly smaller than for either 155 or 140 psi inflation pressures under similar loading conditions, and the vertical force in the center rib increased by approximately 5 lb over that for 155 psi inflation pressure. Although the lateral and drag forces have increased, these forces are still rather small, as shown by the small vectors of the tangential force plot; however, the maximum values of these forces are about 10 and 5 percent of the maximum vertical force, respectively.

The local tire footprint force contours for a vertical load of 16 000 lb are presented in figure 8(b). Although the footprint size is larger than that for a vertical load of 2000 lb, as expected, it is not as large as those for inflation pressures of 140 and 155 psi at the same vertical load. The vertical forces in the center rib are relatively uniform and practically the same as those for 2000 lb of external loading. The maximum lateral and drag forces are about 40 and 20 percent of the maximum vertical force, respectively. The tangential forces in the center rib are basically in the fore and aft directions, whereas those in the adjacent ribs are toward and away from the tire center. These changes in the tangential force directions indicate a signficant change in the tire behavior.

The local tire footprint force contours shown in figure 8(c) are for a vertical load of 30 000 lb. The footprint of the vertical forces is slightly smaller than the similar footprints for inflation pressures of 140 and 155 psi. These forces are relatively uniform and are only a few pounds greater than for an external load of 16 000 lb. The maximum lateral and drag forces are about 40 and 30 percent of the maximum vertical force, respectively. The data show that the drag forces have increased in the outer ribs. Tangential force directions are similar to those that were first observed in figure 8(b), with the resultant loading more complex than that shown in figure 8(b). In the outermost ribs, all the force vectors are pointing toward the tire center.

Three-dimensional plots. The footprint force data are replotted in a three-dimensional format in figure 9 for an inflation pressure of 140 psi. These curves are the unsmoothed data, which charactéristically exhibit ragged profiles. Variations in tire vertical forces, lateral forces, and drag forces are shown in figures 9(a), (b), and (c), respectively, for three vertical loadings (2000, 16 000, and 30 000 lb). The tire ribs, grooves, footprint size, and relative force values are readily apparent. Slightly different viewing angles were used to improve the view of the data.

Vertical forces across footprint midline. Plots of the vertical forces across the midline of the tire footprint for the three external loads are presented in figure 10 for an inflation pressure of 155 psi. In this figure, the vertical force is plotted as a function of the location of the 10 force-measuring devices. Although there should be no forces generated in the grooves, the force curves were not drawn through zero at the grooves. Instead, the curves were faired smoothly through the measured force data to show the general trends across the tire footprint. The footprint vertical forces at the 2000-lb load condition is approximately the same as the footprint forces on the tire centerline for external loads of 16 000 and 30 000 lb. Increasing the external load does not increase the vertical forces generated at the center rib but instead increases the area of the footprint over which these forces act. The peaks on the sides of the curves for vertical loads of 16 000 and 30 000 lb are due to the stiffness of the tire sidewalls, indicating that a significant amount of load is being supported by the sidewalls.

Although beams 4 and 7 were positioned equidistant from the tire centerline, the measured vertical forces were quite different. There was a circumferential flaw in the recapped tire tread at the location of beam 7. About half of the face of beam 7 was positioned on the flaw (see the beam location in the tire cross-section sketch in fig. 10). Beam 7 always loaded first and, therefore, measured the largest forces. This flaw, in conjunction with the tire stiffness, appears to have relieved the load measured by beam 8. It did not measure as much force as beam 3, which was at a similar location on the other side of the tire centerline. An average of the measured forces at beams 7 and 8 for external loadings of 16 000 and 30 000 lb would give force values comparable with those measured on the opposite side of the tire. These data indicate that tire tread nonuniformities significantly influence the measured forces. With the transducer positioned symmetrically about the tire centerline, the faces of beams 3 and 8 were only partially in contact with the tire tread. Approximately half of each of these two beams was over a groove and not in contact with the tire, yet these two beams measured footprint forces as if their entire faces were being loaded. This surprising result strongly suggests that the tire tread is sufficiently stiff to have a significant effect on the load distribution within the footprint. This result also supports the conclusion that the local gradients are very steep along the edges of the tread grooves. These findings indicate that the final load distribution in the tire footprint is the result of a very complicated loading mechanism and cannot be modeled accurately by treating the tire carcass as an inflated membrane alone.

Footprint areas. The footprint areas for the commercial airplane tire are listed in table II. In figure 11, the ratio of the net to gross footprint area is plotted as a function of vertical load. The net footprint area is equal to the gross footprint area minus the tread groove area. A regression analysis was made of the data for footprint area as a function of vertical load for each of the three inflation pressures. The second-order equation shown in figure 11 is the best fit of the experimental data for vertical loads from 10 000 to 30 000 lb. For load values less than 10 000 lb, the data are somewhat erratic. This is because the gross area is changed abruptly by the inclusion of the tread grooves as the tread rib outboard of the groove is first included in the footprint as the vertical load increases.

Footprint aspect ratios. Footprint aspect ratio data for the commercial airplane tire are listed in table II. In figure 12, the aspect ratio (ratio of footprint width to length) is plotted as a function of vertical load. A second-order equation is the best fit of the experimental data for an inflation pressure of 140 psi. A first-order equation, however, fits the data for inflation pressures of 155 and 170 psi. The equations and experimental data are given in figure 12 for vertical loads ranging from 10 000 to 30 000 lb.

Space Shuttle Orbiter Nose Gear Tire

Force data obtained from the tire footprint force transducer for three vertical loads on the 32 × 8.8 tire inflated to 300 psi are presented in figure 13 in the form of contour plots. These plots show the general force distribution patterns within the footprint. Also included in figure 13 are plots of the footprint tangential forces obtained by combining the lateral and drag forces to show the magnitude and direction of the footprint friction forces. The origin of each arrow indicates the location of each data point (beam location). The same types of plots are presented here as were discussed for the 40 × 14 aircraft tire.

Instead of representing the data as a single value at the center of the transducer beam location (as was shown with the 40 × 14 tire data), the decision was made to spread the data. For each measured value, two values were entered in the matrix to be plotted; these values were located in the footprint data matrix at the longitudinal position of the center of the transducer beam at +0.25 in. of the beam center for the lateral position. Thus, the number of data points was doubled and the graphics provided a more realistic visual representation.

Local forces in tire footprint. Footprint force data were collected at three equally spaced locations 120° apart around the tire circumference. The results were similar and, therefore, are shown for one location. Local tire force contours for a vertical load of 2000 lb are presented in figure 13(a). Although at this loading condition the footprint area is small, substantial vertical forces were generated in the two middle ribs.

In figure 13(b) the local force contours for a vertical load of 15 000 lb are presented. As expected, the increase in vertical load caused a substantial increase in the size of the footprint area. The data show that the vertical forces in the two middle ribs are only slightly higher than those observed for the 2000-lb loading shown in figure 13(a). The maximum lateral and drag forces, however, have increased and are about 21 and 10 percent of the maximum vertical force, respectively. The distribution of these frictional forces is more noticeable in the plot of the tangential forces (fig. 13(b)). The frictional forces in the two outer ribs are directed away from the tire centerline. In the fore and aft regions of the two middle ribs, these forces are mostly directed in the fore and aft directions, respectively. These forces gradually change direction from the extremities of the two middle ribs to the center of the footprint, where these forces are directed toward the tire centerline.

The data presented in figure 13(c) are for a vertical load of 30 000 lb. The vertical forces in the two middle ribs are rather uniform, and the peak values are not very much greater than those for the smaller vertical loads. The maximum lateral and drag forces generated in the footprint are about 37 and 17 percent of the maximum vertical force, respectively. These frictional or tangential forces are more complicated than for the 15 000-lb vertical load. In the two outer ribs, forces are directed both toward and away from the tire centerline. For most of the two center ribs, these tangential forces are similar to those shown for the 15 000-lb-load footprint. Near the bottom of the footprint, however, there is an abrupt change in the direction of the tangential forces in all four ribs. The magnitude and direction of these tangential forces are affected by tire construction and viscoelastic properties.

Local vertical forces across footprint midline. Plots of the normalized vertical forces across the midline of the footprint for the three vertical loads are presented in figure 14. In this figure, the normalized vertical force is plotted as a function of the location of the 10 force-measuring devices. Since the tread surface quality of the tire was good (much better than that of the 40 × 14 tire), the data are relatively smooth. As with the 40 × 14 tire, increasing the vertical load did not increase the peak force measured. Only the footprint area increased.

Footprint areas. Footprint area data (see table III) were taken at three locations 120° apart. Figure 15 shows the ratio of footprint net to gross area as a function of vertical load. For comparison, the data for all three footprints are plotted together. The linear equation given in figure 15 is a very good fit of the data between 10 000 and 30 000 lb of vertical load.

Footprint aspect ratios. The footprint aspect ratio data (see table III) are presented in figure 16 and plotted as a function of vertical load. For vertical loads between 10 000 and 30 000 lb, a linear equation is an excellent fit of the data.

Space Shuttle Orbiter Main Gear Tire

Footprint area. Only one footprint area was measured on the Space Shuttle orbiter main gear tire. These data (see table IV) are presented in figure 17, where the ratio of net to gross area is plotted as a function of vertical load. A first-order regression equation is used to fit the data between 10 000 and 66 000 lb of vertical load. In general, the higher the vertical load, the higher the footprint area ratio.

Footprint aspect ratio. The footprint aspect ratio data (see table IV) are presented in figure 18 as a function of vertical load. A linear regression equation is a good fit of the data between 10 000 and 66 000 lb. In general, the higher the vertical load, the lower the footprint aspect ratio.

Conclusions

An experimental apparatus has been built and a test technique has been developed to determine the forces generated in the tire footprints at the contact surface. The data gathered by this apparatus and reported herein are preliminary results of measured footprint forces. The major conclusions drawn from these data are

1. The local vertical force in the footprint center area reaches a maximum value at the lowest applied load (2000 lb) and maintains that force throughout the range of loading (30 000 lb).
2. The footprint area increased as the vertical load was increased.
3. Tire tread nonuniformities significantly influence the measured local forces.
4. The load distribution in the footprint is the result of a very complicated loading behavior. This local loading behavior suggests that accurate modeling of the tire cannot be accomplished by treating the tire carcass as a simple inflated membrane.
5. The footprint area ratios and/or aspect ratios, as a function of vertical load, can be defined by first- or second-order regression equations.

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Appendix

Tire Footprint Data

The purpose of this appendix is to give the reader a set of the tire footprint data. Each set of footprint force data is presented in a matrix format, and the relative footprint measurement location is indicated. Whereas the contour plots contained in the report show relative trends, specific data are given in this appendix. Included in this appendix, also, are copies of the footprints from which the area ratio and aspect ratio data were obtained.

Guide to Tire Footprint Force Data

Tire	Force direction	Vertical load, lb	Inflation pressure, psi	Page
40 × 14	Vertical	2 000	140	9
		16 000		10
		30 000		11
		2 000	155	12
		16 000		13
		30 000		14
		2 000	170	15
		16 000		16
		30 000		17
	Lateral	2 000	140	18
		16 000		19
		30 000		20
		2 000	155	21
		16 000		22
		30 000		23
		2 000	170	24
		16 000		25
		30 000		26
	Drag	2 000	140	27
		16 000		28
		30 000		29
		2 000	155	30
		16 000		31
		30 000		32
		2 000	170	33
		16 000		34
		30 000		35
32 × 8.8	Vertical	2 000	300	36
		15 000		37
		30 000		38
	Lateral	2 000	300	39
		15 000		40
		30 000		41
	Drag	2 000	300	42
		15 000		43
		30 000		44

Guide to Tire Footprints

Tire	Vertical load, lb	Inflation pressure, psi	Page
40 × 14	2 000	140	45
		155	46
		170	47
	16 000	140	48
		155	49
		170	50
	30 000	140	51
		155	52
		170	53
32 × 8.8	2 000	300	54
	15 000		55
	30 000		56
44.5 × 16	2 000	315	57
	30 000		58
	60 000		59
	66 000		60

40 × 14 Commercial Airplane Tire Footprint Force Data

[Vertical load = 2000 lb; tire pressure = 140 psi]

Circumferential position		Vertical force, lb, at—									
		Left of centerline, in.					Right of centerline, in.				
Location	in.	−6.12	−4.76	−3.40	−2.04	−0.68	0.68	2.04	3.40	4.76	6.12
	9.0										
	8.5										
	8.0										
	7.5										
	7.0										
	6.5										
	6.0										
	5.5										
	5.0										
Forward	4.5										
	4.0										
	3.5							00.1			
	3.0					00.6	04.9	00.3			
	2.5					09.8	19.1	04.1			
	2.0				00.9	35.5	40.3	27.8	00.1		
	1.5			00.1	05.0	42.1	48.6	38.6	00.2		
	1.0				07.0	45.0	49.4	45.4			
	0.5				17.7	45.8	50.5	43.8	00.1		
Center	0.0				20.5	47.5	50.6	58.4			
	−0.5				14.4	45.9	50.3	36.3			
	−1.0				00.5	40.8	46.9	46.2			
	−1.5					13.3	24.4	05.4			
	−2.0										
	−2.5										
	−3.0										
	−3.5										
	−4.0										
Aft	−4.5										
	−5.0										
	−5.5										
	−6.0										
	−6.5										
	−7.0										
	−7.5										
	−8.0										
	−8.5										
	−9.0										

40 × 14 Commercial Airplane Tire Footprint Force Data

[Vertical load = 16 000 lb; tire pressure = 140 psi]

Circumferential position		Vertical force, lb, at—									
		Left of centerline, in.					Right of centerline, in.				
Location	in.	−6.12	−4.76	−3.40	−2.04	−0.68	0.68	2.04	3.40	4.76	6.12
	9.0										
	8.5										
	8.0										
	7.5										
	7.0										
	6.5				04.4	11.7	15.5	31.1	00.1		
	6.0			01.2	31.7	38.0	39.9	55.4	07.5		
	5.5			11.6	43.0	44.2	45.5	63.2	18.2		
	5.0			42.4	53.1	47.5	47.0	73.1	29.2		
Forward	4.5			57.0	55.7	48.1	48.6	73.4	36.8		
	4.0			59.2	56.8	50.2	50.0	73.2	44.1	04.1	
	3.5			52.3	54.8	50.7	48.3	69.2	50.5	22.0	
	3.0		05.1	63.4	55.7	48.8	48.4	72.6	38.5	11.5	
	2.5		08.8	59.6	54.0	48.7	47.3	70.0	42.6	20.5	
	2.0		06.7	44.4	47.4	48.6	47.4	66.5	50.8	36.3	
	1.5		15.5	58.9	54.7	46.5	47.7	69.1	41.0	23.8	00.2
	1.0		14.5	55.4	51.6	47.8	48.6	69.1	43.2	30.1	
	0.5		23.1	66.4	53.2	46.5	49.4	71.3	33.8	18.7	
Center	0.0		17.4	62.2	53.8	47.5	49.7	73.5	38.4	21.6	
	−0.5		22.6	66.0	53.1	48.2	50.9	70.6	34.0	16.4	
	−1.0		04.3	43.7	43.0	49.0	48.0	70.9	53.5	40.2	
	−1.5		13.3	69.1	52.2	47.0	49.5	69.5	33.2	08.9	
	−2.0		05.0	61.6	48.8	44.3	43.6	67.3	39.1	10.1	
	−2.5		09.2	67.4	51.4	43.7	44.5	64.1	32.8	04.4	
	−3.0		04.2	71.6	51.9	39.2	40.1	59.9	30.5	00.4	
	−3.5			49.3	47.7	56.3	54.8	77.2	57.8	11.3	
	−4.0			45.9	44.9	53.2	51.7	75.3	50.3	04.9	
Aft	−4.5			38.4	50.4	48.3	47.4	69.4	34.1		
	−5.0			18.6	45.6	45.0	44.7	65.8	23.4		
	−5.5			04.1	27.2	37.9	37.8	58.1	05.6		
	−6.0				08.3	07.6	09.5	26.0			
	−6.5							01.8			
	−7.0										
	−7.5										
	−8.0										
	−8.5										
	−9.0										

40 × 14 Commercial Airplane Tire Footprint Force Data

[Vertical load = 30 000 lb; tire pressure = 140 psi]

Circumferential position		Vertical force, lb, at—									
		Left of centerline, in.					Right of centerline, in.				
Location	in.	−6.12	−4.76	−3.40	−2.04	−0.68	0.68	2.04	3.40	4.76	6.12
	9.0						00.1				
	8.5			00.6	08.2	13.0	14.7	33.6	02.9		
	8.0		00.1	27.4	42.7	42.0	41.9	49.4	29.0	05.0	
	7.5		00.1	53.9	52.8	48.3	47.6	63.1	42.6	15.7	
	7.0		17.7	56.0	54.6	48.2	48.4	72.0	39.5	25.3	
	6.5		38.5	66.7	53.1	47.4	47.4	70.9	42.9	51.8	
	6.0		50.8	68.1	54.6	47.0	46.9	69.3	42.5	62.0	
	5.5		59.8	64.6	54.2	47.2	47.7	69.1	41.7	67.1	
	5.0		65.3	67.9	54.4	48.0	46.4	72.3	34.1	59.3	
Forward	4.5		68.3	66.1	54.6	47.5	47.1	71.4	33.2	61.7	
	4.0		69.0	60.4	54.4	48.5	48.2	69.6	36.9	65.3	
	3.5		64.2	46.7	52.0	48.7	46.8	67.5	45.8	73.1	00.1
	3.0		73.1	57.5	53.8	47.6	47.4	70.5	33.7	53.3	00.1
	2.5	00.1	73.0	54.0	52.1	47.8	46.8	67.7	35.1	59.0	00.1
	2.0	00.1	52.1	46.1	44.5	47.8	46.4	65.0	44.9	70.3	03.6
	1.5	00.1	71.0	52.6	52.2	47.8	66.9	66.9	34.3	56.7	00.2
	1.0		64.1	48.5	50.5	48.7	48.9	67.6	36.6	59.4	00.1
	0.5	00.1	74.3	59.7	52.5	47.6	50.4	69.0	43.2	47.7	00.1
Center	0.0		73.6	56.4	53.1	48.4	50.5	71.4	34.2	53.9	00.1
	−0.5		73.8	61.0	52.8	49.1	50.6	66.8	46.3	46.1	
	−1.0		53.0	45.9	42.1	49.0	47.8	68.7	45.5	70.8	04.6
	−1.5		73.7	64.0	51.0	46.2	48.4	64.8	42.8	43.1	
	−2.0		74.5	55.9	46.6	43.9	43.1	63.5	32.1	56.2	
	−2.5		76.1	62.1	49.7	43.5	43.8	60.1	41.8	44.7	
	−3.0		77.4	68.2	50.2	37.6	38.0	54.3	36.4	43.6	
	−3.5		53.7	46.3	43.2	53.7	52.7	73.3	51.0	76.7	
	−4.0		58.3	48.0	42.0	50.1	49.5	70.5	46.1	66.6	
Aft	−4.5		61.6	56.6	49.8	47.1	46.5	67.0	41.8	64.5	
	−5.0		58.3	62.1	53.6	47.6	46.6	69.1	46.0	65.8	
	−5.5		56.5	55.7	48.8	47.8	46.7	69.3	53.4	64.9	
	−6.0		49.9	65.5	52.2	46.4	46.0	69.0	48.8	57.2	
	−6.5		42.0	67.6	53.6	46.3	45.8	68.8	48.5	46.7	
	−7.0		03.5	58.0	50.0	46.8	45.9	70.2	54.5	34.9	
	−7.5			47.6	43.0	49.1	45.5	61.9	36.6	22.3	
	−8.0			17.3	41.6	36.7	37.5	58.3	16.4		
	−8.5			00.1	11.0	06.5	09.2	31.9	00.7		
	−9.0							01.2	00.1		

40 × 14 Commercial Airplane Tire Footprint Force Data

[Vertical load = 2000 lb; tire pressure = 155 psi]

Circumferential position		Vertical force, lb, at—									
		Left of centerline, in.					Right of centerline, in.				
Location	in.	−6.12	−4.76	−3.40	−2.04	−0.68	0.68	2.04	3.40	4.76	6.12
	9.0										
	8.5										
	8.0										
	7.5										
	7.0										
	6.5										
	6.0										
	5.5										
	5.0										
Forward	4.5										
	4.0										
	3.5										
	3.0										
	2.5					04.0	14.7	02.3			
	2.0					14.2	30.9	09.0			
	1.5				04.2	46.3	53.0	47.0	00.1		
	1.0				13.2	50.8	55.8	54.8			
	0.5				15.3	50.5	53.2	47.9			
Center	0.0				09.6	49.5	53.3	48.7			
	−0.5				04.7	48.6	54.0	40.4			
	−1.0					40.5	49.7	38.7			
	−1.5					26.1	39.2	19.5			
	−2.0						00.1	00.1			
	−2.5										
	−3.0										
	−3.5										
	−4.0										
Aft	−4.5										
	−5.0										
	−5.5										
	−6.0										
	−6.5										
	−7.0										
	−7.5										
	−8.0										
	−8.5										
	−9.0										

40 × 14 Commercial Airplane Tire Footprint Force Data

[Vertical load = 16 000 lb; tire pressure = 155 psi]

Circumferential position		Vertical force, lb, at—									
		Left of centerline, in.					Right of centerline, in.				
Location	in.	−6.12	−4.76	−3.40	−2.04	−0.68	0.68	2.04	3.40	4.76	6.12
	9.0										
	8.5										
	8.0										
	7.5										
	7.0					00.1		03.5			
	6.5				01.7	06.6	09.3	19.1			
	6.0				27.4	38.0	40.6	53.9	02.7		
	5.5			05.8	43.6	47.3	49.3	66.8	15.5		
	5.0			29.5	56.7	52.1	52.8	75.6	31.0		
Forward	4.5			47.1	61.8	53.7	54.3	77.2	43.7		
	4.0			58.1	62.3	55.7	55.4	78.0	49.6	03.5	
	3.5			62.6	62.7	56.2	55.6	78.1	51.9	10.1	
	3.0			56.8	62.2	55.7	55.1	77.9	49.7	02.6	
	2.5		00.6	63.1	60.5	54.6	54.9	77.0	51.8	16.6	
	2.0		01.9	62.7	60.6	54.4	55.6	76.4	51.2	17.0	
	1.5		04.9	63.0	59.3	53.9	55.9	76.9	52.1	22.5	
	1.0		05.1	68.7	60.9	54.0	56.2	78.9	46.6	17.9	
	0.5		11.4	67.0	58.6	52.4	54.2	78.6	45.4	15.5	
Center	0.0		09.7	65.6	58.1	52.8	53.4	78.2	47.3	18.5	
	−0.5	00.1	05.5	62.2	57.3	53.1	55.6	78.6	50.6	20.7	
	−1.0		01.5	51.9	53.0	55.3	53.6	78.1	57.6	27.2	
	−1.5		01.1	63.0	55.0	52.1	53.7	78.8	51.3	15.4	
	−2.0			51.2	47.8	53.9	51.5	77.1	56.6	21.8	
	−2.5			54.4	50.0	52.6	49.6	76.0	53.7	13.2	
	−3.0			56.6	50.2	47.2	44.5	73.6	49.2	07.8	
	−3.5			43.8	51.9	64.3	61.3	90.2	68.4	09.7	
	−4.0			28.6	41.8	62.4	56.9	79.8	52.4	06.3	
Aft	−4.5			29.2	44.4	54.7	52.5	80.5	42.3	00.1	
	−5.0			09.6	36.4	48.7	47.3	72.1	14.5		
	−5.5				14.7	18.3	22.0	42.2	00.2		
	−6.0					02.3	01.0	26.8	00.1		
	−6.5					00.1		00.2			
	−7.0					00.1		01.2			
	−7.5										
	−8.0										
	−8.5										
	−9.0										

40 × 14 Commercial Airplane Tire Footprint Force Data

[Vertical load = 30 000 lb; tire pressure = 155 psi]

Circumferential position		Vertical force, lb, at—									
		Left of centerline, in.					Right of centerline, in.				
Location	in.	−6.12	−4.76	−3.40	−2.04	−0.68	0.68	2.04	3.40	4.76	6.12
	9.0				00.1	00.1	00.1	00.1			
	8.5				00.1	00.1	00.1	08.3	00.1		
	8.0			02.4	30.1	35.0	36.2	52.3	09.8	00.1	
	7.5			58.8	59.7	53.0	53.6	66.7	49.5	18.0	
	7.0		06.2	65.6	58.0	53.0	52.6	72.0	49.3	28.6	
	6.5		28.9	75.6	60.8	52.5	52.3	73.1	51.3	48.0	
	6.0		44.9	75.9	60.0	52.6	52.8	74.8	50.7	61.3	
	5.5		53.1	74.7	60.0	52.7	53.2	75.7	49.6	69.5	
	5.0		58.9	76.2	61.6	53.7	53.5	77.7	46.1	67.5	
Forward	4.5		62.5	70.4	61.7	54.0	54.3	76.4	48.9	74.1	
	4.0		69.5	66.8	60.7	55.0	54.5	76.8	50.0	77.6	
	3.5		70.9	64.5	60.9	55.7	54.6	77.0	49.5	76.7	
	3.0		74.3	63.1	60.3	55.2	53.6	76.2	48.6	76.2	
	2.5		73.6	61.7	59.5	54.7	54.3	75.5	48.5	75.1	
	2.0		74.7	60.4	59.3	54.5	55.1	74.7	47.8	74.2	
	1.5		74.6	59.8	58.3	54.4	56.3	76.0	49.6	75.9	
	1.0		76.1	65.8	60.7	55.2	57.5	78.3	42.4	69.8	
	0.5		76.7	63.5	58.1	53.2	55.9	77.7	41.7	67.7	
Center	0.0		76.1	61.4	57.7	53.8	54.7	77.0	42.3	68.5	
	−0.5		74.4	58.7	55.6	52.6	55.7	76.9	47.8	75.0	
	−1.0		66.8	48.5	52.8	55.3	53.8	76.5	55.3	80.2	
	−1.5		73.8	60.5	52.5	51.1	54.0	77.0	49.3	74.2	
	−2.0		64.2	48.6	46.5	53.0	51.1	74.9	55.6	77.5	
	−2.5		71.1	53.4	47.5	51.4	48.8	73.4	54.4	74.3	
	−3.0		71.7	60.0	48.2	46.8	44.9	71.2	51.4	66.5	
	−3.5		48.9	48.9	49.6	61.5	59.6	86.3	71.0	87.0	
	−4.0		42.7	42.9	41.1	59.1	54.6	77.9	61.7	81.7	
Aft	−4.5		52.4	48.1	45.9	53.2	50.9	76.9	61.2	74.5	
	−5.0		47.0	57.8	52.2	53.6	51.3	78.3	61.8	70.5	
	−5.5		45.2	70.7	59.2	52.4	52.0	78.4	57.0	58.0	
	−6.0		09.0	49.3	45.3	57.5	50.5	91.7	49.5	61.6	
	−6.5		00.2	57.1	54.9	53.3	50.9	81.0	53.4	27.8	
	−7.0		00.1	48.7	55.0	50.8	50.5	74.3	49.4	10.4	
	−7.5			17.5	41.6	40.7	41.8	64.0	21.7	00.1	
	−8.0			00.1	23.3	14.5	17.7	40.9	01.7		
	−8.5				11.3	08.8	09.7	32.5	00.1		
	−9.0										

40 × 14 Commercial Airplane Tire Footprint Force Data

[Vertical load = 2000 lb; tire pressure = 170 psi]

Circumferential position		Vertical force, lb, at—									
		Left of centerline, in.					Right of centerline, in.				
Location	in.	−6.12	−4.76	−3.40	−2.04	−0.68	0.68	2.04	3.40	4.76	6.12
	9.0										
	8.5										
	8.0										
	7.5										
	7.0										
	6.5										
	6.0										
	5.5										
	5.0										
Forward	4.5										
	4.0										
	3.5										
	3.0										
	2.5					00.3	05.8				
	2.0					25.5	39.1	14.4			
	1.5				02.6	51.3	58.3	49.9			
	1.0				07.5	53.6	56.6	52.8			
	0.5				07.1	55.1	58.7	62.9			
Center	0.0				21.5	56.0	61.0	54.6			
	−0.5				06.6	54.8	60.5	46.5			
	−1.0				00.4	49.1	57.7	40.1			
	−1.5				25.8	59.2	60.7	63.5			
	−2.0					06.6	24.4	08.5			
	−2.5										
	−3.0										
	−3.5										
	−4.0										
Aft	−4.5										
	−5.0										
	−5.5										
	−6.0										
	−6.5										
	−7.0										
	−7.5										
	−8.0										
	−8.5										
	−9.0										

40 × 14 Commercial Airplane Tire Footprint Force Data

[Vertical load = 16 000 lb; tire pressure = 170 psi]

Circumferential position		Vertical force, lb, at—									
		Left of centerline, in.					Right of centerline, in.				
Location	in.	−6.12	−4.76	−3.40	−2.04	−0.68	0.68	2.04	3.40	4.76	6.12
	9.0										
	8.5										
	8.0										
	7.5										
	7.0										
	6.5										
	6.0							04.0			
	5.5				11.6	29.5	29.8	25.2			
	5.0			04.9	42.1	51.7	52.8	62.9	07.5		
Forward	4.5			25.1	64.3	57.8	58.8	82.5	25.3		
	4.0			41.2	65.5	61.1	61.2	84.1	45.2		
	3.5			46.9	64.6	64.2	61.7	82.9	53.5	08.4	
	3.0			56.3	66.1	62.4	61.1	84.8	60.6	14.3	
	2.5			59.1	65.5	62.5	62.0	85.0	60.9	15.5	
	2.0			47.1	60.6	62.7	61.6	81.6	57.7	24.1	
	1.5		00.3	57.5	61.9	60.6	60.3	84.7	63.3	25.6	
	1.0		00.5	57.8	61.4	58.5	57.9	81.0	62.3	27.7	
	0.5		00.2	58.4	61.0	60.0	58.9	84.9	63.3	29.5	
Center	0.0		07.4	73.0	69.1	58.5	61.3	84.5	43.3	09.1	
	−0.5		01.8	69.0	62.1	59.6	61.7	85.2	54.9	16.3	
	−1.0		00.4	67.8	63.8	61.6	61.6	87.3	55.1	15.5	
	−1.5			71.8	62.7	60.4	61.1	84.9	51.6	10.2	
	−2.0			64.3	60.2	59.3	58.7	85.3	56.6	13.1	
	−2.5			61.0	57.3	56.3	55.9	82.3	54.6	10.0	
	−3.0			70.7	62.7	50.5	51.6	78.6	45.4		
	−3.5			52.7	67.3	68.7	68.2	92.0	49.6		
	−4.0			38.3	59.5	66.4	64.8	89.5	49.6		
Aft	−4.5			19.3	59.7	58.1	58.7	79.2	26.9		
	−5.0			01.1	41.0	50.8	52.1	69.8	10.2		
	−5.5				17.8	25.7	29.8	46.0	00.4		
	−6.0				01.5	02.4	02.9	11.2	00.1		
	−6.5										
	−7.0										
	−7.5										
	−8.0										
	−8.5										
	−9.0										

40 × 14 Commercial Airplane Tire Footprint Force Data

[Vertical load = 30 000 lb; tire pressure = 170 psi]

Circumferential position		Vertical force, lb, at									
		Left of centerline, in.					Right of centerline, in.				
Location	in.	−6.12	−4.76	−3.40	−2.04	−0.68	0.68	2.04	3.40	4.76	6.12
	9.0										
	8.5										
	8.0										
	7.5			00.4	14.8	19.6	21.4	30.5	00.9		
	7.0			19.1	47.5	48.5	49.6	67.8	22.1		
	6.5			36.1	61.0	54.7	54.7	78.9	33.3	00.5	
	6.0		06.0	74.9	68.6	59.0	59.2	80.0	58.4	31.7	
	5.5		14.7	64.0	68.3	61.4	59.9	73.1	56.7	72.0	
	5.0		32.4	64.8	68.1	61.1	59.9	82.0	62.9	77.3	
Forward	4.5		60.0	75.2	70.4	59.7	60.2	87.5	44.9	54.5	
	4.0		55.9	74.4	67.4	62.3	60.8	84.5	59.6	74.9	
	3.5		54.1	55.7	63.6	64.8	61.1	83.3	63.0	86.5	
	3.0		68.0	60.4	65.0	63.2	61.3	84.6	63.3	84.5	
	2.5		70.3	61.1	64.4	63.2	62.2	82.7	62.1	83.6	
	2.0		56.9	47.5	59.2	63.7	62.4	83.0	61.6	89.6	
	1.5		68.3	56.7	61.7	61.8	61.3	84.0	62.9	85.9	
	1.0		68.1	56.0	60.3	59.1	59.3	80.5	61.4	84.6	
	0.5		67.6	57.4	60.4	61.0	60.3	85.3	61.5	85.0	
Center	0.0		80.4	75.7	67.8	59.0	62.0	83.3	41.9	63.0	
	−0.5		77.2	69.8	61.9	60.5	63.2	84.9	54.7	80.0	
	−1.0		75.9	69.5	63.1	62.0	62.6	86.6	55.2	79.9	
	−1.5		75.5	75.2	61.7	60.6	61.9	84.0	51.6	75.5	
	−2.0		74.8	67.9	57.3	57.8	59.4	84.5	58.1	78.0	
	−2.5		74.5	66.4	55.2	55.2	56.1	81.2	57.5	75.6	
	−3.0		74.7	81.1	61.2	50.2	52.4	77.4	49.4	60.5	
	−3.5		58.3	75.0	65.0	65.9	66.5	89.4	54.4	68.3	
	−4.0		49.5	65.9	60.7	65.4	63.4	87.7	64.5	71.1	
Aft	−4.5		46.9	72.7	64.9	61.3	60.0	83.7	57.6	62.7	
	−5.0		41.9	77.9	67.9	61.2	59.9	84.8	58.2	58.9	
	−5.5		27.5	77.0	67.2	59.8	58.9	85.1	64.0	47.3	
	−6.0		04.2	65.5	62.7	60.3	57.7	87.8	67.2	44.7	
	−6.5			62.0	63.7	60.5	58.1	86.6	60.1	19.1	
	−7.0			38.4	57.0	53.6	54.5	77.6	40.0	02.2	
	−7.5			00.4	42.4	31.6	37.6	55.4	07.9		
	−8.0				05.5	03.3	05.2	20.7			
	−8.5										
	−9.0										

40 × 14 Commercial Airplane Tire Footprint Force Data

[Vertical load = 2000 lb; tire pressure = 140 psi]

Circumferential position		Lateral force, lb, at—									
		Left of centerline, in.					Right of centerline, in.				
Location	in.	−6.12	−4.76	−3.40	−2.04	−0.68	0.68	2.04	3.40	4.76	6.12
	9.0										
	8.5										
	8.0										
	7.5										
	7.0										
	6.5										
	6.0										
	5.5										
	5.0										
Forward	4.5										
	4.0							00.1			
	3.5							00.4			
	3.0				−00.1			00.1			
	2.5				−00.1	−00.6	−00.7	00.5			
	2.0				−00.2	01.2	−01.3	05.0			
	1.5				−00.4	−00.4	−00.1	05.7			
	1.0				−01.4	−00.2	−00.1	06.7			
	0.5				−03.3	−01.1	−01.3	07.3			
Center	0.0				−05.5	−02.5	00.2	10.1			
	−0.5				−04.2	−02.8	−02.2	04.7			
	−1.0					00.6	−00.1	07.3			
	−1.5					−00.1	−00.7	00.6			
	−2.0										
	−2.5										
	−3.0										
	−3.5										
	−4.0										
Aft	−4.5										
	−5.0										
	−5.5										
	−6.0										
	−6.5										
	−7.0										
	−7.5										
	−8.0										
	−8.5										
	−9.0										

40 × 14 Commercial Airplane Tire Footprint Force Data

[Vertical load = 16 000 lb; tire pressure = 140 psi]

Circumferential position		Lateral force, lb, at—									
		Left of centerline, in.					Right of centerline, in.				
Location	in.	−6.12	−4.76	−3.40	−2.04	−0.68	0.68	2.04	3.40	4.76	6.12
	9.0										
	8.5										
	8.0										
	7.5										
	7.0										
	6.5				−00.4	00.3	−00.3	04.8			
	6.0			00.1	−04.2	00.5	−00.9	06.4	−00.1		
	5.5			00.2	−06.8	01.3	−00.9	09.5	00.6		
	5.0			03.0	−09.2	−00.6	00.4	09.0	02.9		
Forward	4.5			−02.3	−13.5	00.7	−01.4	18.2	07.4		
	4.0			−06.2	−16.9	02.9	−00.9	25.7	10.7	01.4	
	3.5			−08.7	−18.4	04.6	00.4	16.2	11.4	06.5	
	3.0		−01.7	−10.6	−16.7	00.8	−01.1	23.7	12.9	03.1	
	2.5		−02.6	−09.5	−17.4	−00.5	01.8	16.8	09.2	06.0	
	2.0		−02.7	−09.3	−15.6	−04.5	01.0	15.7	12.8	10.3	
	1.5		−04.5	−09.2	−06.7	−05.4	04.1	11.0	10.5	06.6	
	1.0		−05.0	−08.6	−14.5	−04.8	02.8	15.4	11.3	07.2	
	0.5		−07.3	−10.3	−10.4	−04.1	02.3	22.2	07.2	06.2	
Center	0.0		−05.5	−10.2	−20.2	−04.7	02.4	26.4	10.5	07.7	
	−0.5		−06.2	−11.6	−18.6	−05.5	−00.1	21.7	12.3	06.3	
	−1.0		−01.2	−09.2	−13.1	−01.6	01.9	14.9	13.5	14.9	
	−1.5		−03.4	−09.1	−18.1	−02.9	−00.7	18.7	07.9	03.5	
	−2.0		−01.0	−05.5	−17.0	−01.6		13.4	08.4	03.2	
	−2.5		−02.4	−05.3	−13.1	−01.7	−02.7	13.5	04.8	01.3	
	−3.0		−01.0	−04.1	−13.5	−01.4	−00.9	10.2	03.6	00.1	
	−3.5			−05.2	−14.2	−00.6	−05.0	17.6	04.8	03.1	
	−4.0			−03.2	−11.3	02.5	−06.8	17.5	06.3	01.6	
Aft	−4.5			−02.1	−13.8	05.3	−05.5	17.3	03.2		
	−5.0				−08.5	03.0	−03.8	14.5	00.3		
	−5.5			−00.3	−06.4	02.0	−02.5	10.5	00.3		
	−6.0				−01.7	−00.1	−00.6	03.5			
	−6.5				−00.1	−00.1		00.3			
	−7.0										
	−7.5										
	−8.0										
	−8.5										
	−9.0										

40 × 14 Commercial Airplane Tire Footprint Force Data

[Vertical load = 30 000 lb; tire pressure = 140 psi]

Circumferential position		Lateral force, lb, at--									
		Left of centerline, in.					Right of centerline, in.				
Location	in.	−6.12	−4.76	−3.40	−2.04	−0.68	0.68	2.04	3.40	4.76	6.12
	9.0										
	8.5										
	8.0			−00.2	−04.4	03.0	00.1	10.3	04.3	01.3	
	7.5			01.1	−06.0	03.0	01.0	08.0	04.5	03.9	
	7.0		−04.2	−01.5	−06.9	01.4	01.0	12.7	07.2	05.0	
	6.5		−10.0	−03.9	−07.1	02.5	01.3	17.1	10.5	11.1	
	6.0		−09.9	−06.0	−06.4	02.0	01.9	14.2	08.4	11.3	
	5.5		−12.8	−08.7	−08.0	01.9	01.6	17.5	10.2	14.3	
	5.0		−15.0	−08.4	−09.6	00.8	−01.8	17.2	09.5	14.8	
Forward	4.5		−16.6	−14.2	−12.8	01.8	00.3	20.7	12.1	19.0	
	4.0		−17.7	−16.4	−14.2	03.4	−00.7	20.9	12.9	19.3	
	3.5		−17.9	−15.9	−15.6	05.2	00.8	13.4	15.6	24.6	
	3.0		−22.2	−16.5	−12.4	02.9	−01.0	24.9	10.1	17.0	
	2.5		−23.1	−14.5	−13.4	00.9	00.4	13.9	11.1	17.6	
	2.0		−18.3	−14.7	−13.2	−01.8	−00.8	13.2	14.5	19.9	
	1.5		−19.8	−12.8	−05.7	−04.4	03.5	10.8	11.7	18.5	
	1.0		−18.1	−11.6	−14.0	−04.2	03.3	15.3	12.2	15.8	
	0.5		−23.5	−15.1	−10.0	−04.4	03.2	22.2	13.7	12.6	
Center	0.0		−22.9	−14.4	−18.9	−05.1	02.6	25.6	12.7	18.5	
	−0.5		−20.0	−15.6	−17.7	−05.9	01.1	20.6	17.6	16.9	
	−1.0		−14.6	−13.0	−13.1	−02.7	01.3	13.7	13.2	22.3	
	−1.5		−18.1	−14.1	−15.2	−03.1	−01.9	17.4	09.8	15.0	
	−2.0		−15.5	−10.9	−14.1	−00.2	−00.9	14.2	09.1	19.4	
	−2.5		−15.1	−10.9	−10.9	−00.8	−00.7	14.7	07.6	15.3	
	−3.0		−17.5	−12.0	−11.9	−00.9	00.4	10.7	05.3	14.1	
	−3.5		−13.4	−13.2	−10.9	−01.5	−05.5	16.6	13.0	24.8	
	−4.0		−11.2	−12.2	−09.8	01.5	−03.7	18.8	13.1	20.6	
Aft	−4.5		−13.3	−16.0	−12.4	01.1	−02.8	17.2	13.7	19.4	
	−5.0		−11.9	−15.9	−06.0	01.3	−01.8	16.7	13.8	18.0	
	−5.5		−10.7	−12.9	−09.2	−00.6	−02.4	13.9	12.2	15.9	
	−6.0		−10.1	−09.3	−03.8	00.9	−01.5	10.3	09.5	14.1	
	−6.5		−08.6	−07.0	−07.3		−00.8	09.7	07.3	08.3	
	−7.0		−00.6	−05.7	−06.1	−00.2	−02.5	07.9	03.0	08.6	
	−7.5			−03.9	−08.2	00.4	−02.2	05.5	02.0	06.3	
	−8.0		−00.1	−00.3	−08.1	00.6	−02.4	07.1	01.4		
	−8.5										
	−9.0										

40 × 14 Commercial Airplane Tire Footprint Force Data

[Vertical load = 2000 lb; tire pressure = 155 psi]

Circumferential position		Lateral force, lb, at—									
		Left of centerline, in.					Right of centerline, in.				
Location	in.	−6.12	−4.76	−3.40	−2.04	−0.68	0.68	2.04	3.40	4.76	6.12
	9.0										
	8.5										
	8.0										
	7.5										
	7.0										
	6.5										
	6.0										
	5.5										
	5.0										
Forward	4.5										
	4.0							00.2			
	3.5							00.4			
	3.0							00.3			
	2.5				−00.1		−00.1	00.4			
	2.0				−00.1	−00.3	−00.8	01.1			
	1.5				−00.9	−00.8	−00.5	06.1			
	1.0				−02.1	−01.8	−00.7	06.1			
	0.5				−03.4	−00.1	02.3	05.5			
Center	0.0				−02.6	−02.0	−00.8	05.1			
	−0.5				−01.0	−00.5	−00.2	04.9			
	−1.0						00.3	06.3			
	−1.5						−01.1	02.0			
	−2.0										
	−2.5										
	−3.0										
	−3.5										
	−4.0										
Aft	−4.5										
	−5.0										
	−5.5										
	−6.0										
	−6.5										
	−7.0										
	−7.5										
	−8.0										
	−8.5										
	−9.0										

40 × 14 Commercial Airplane Tire Footprint Force Data

[Vertical load = 16 000 lb; tire pressure = 155 psi]

Circumferential position		Lateral force, lb, at—									
		Left of centerline, in.					Right of centerline, in.				
Location	in.	−6.12	−4.76	−3.40	−2.04	−0.68	0.68	2.04	3.40	4.76	6.12
	9.0										
	8.5										
	8.0										
	7.5										
	7.0						−00.1	00.1			
	6.5				−00.1	00.2	−00.2	00.9			
	6.0				−03.3	00.4	−01.0	03.9	−00.2		
	5.5			00.4	−05.7	−00.1	−01.0	06.2	−00.7		
	5.0			01.0	−09.2	00.1	−02.3	10.0	00.8		
Forward	4.5			−00.7	−14.9	−00.2	−01.8	16.0	03.5		
	4.0			−04.1	−20.3	02.7	00.7	19.0	05.9	00.9	
	3.5			−06.3	−22.3	04.6	04.4	21.7	07.8	02.8	
	3.0			−06.6	−20.1	02.8	03.7	22.5	08.2	03.5	
	2.5		−00.2	−08.3	−15.8	00.2	04.6	19.9	10.8	04.5	
	2.0		−00.5	−08.0	−15.2	−03.3	02.2	20.3	11.6	05.0	
	1.5		−01.2	−07.6	−14.7	−05.0	02.2	24.2	09.9	06.3	
	1.0		−01.1	−07.7	−17.3	−05.0	02.0	25.5	09.4	05.7	
	0.5		−02.6	−08.6	−17.6	−03.9	05.1	21.2	07.0	04.2	
Center	0.0		−02.1	−08.8	−20.4	−06.0	00.3	17.9	06.7	04.9	
	−0.5		−01.3	−08.0	−14.7	−02.9	02.4	20.3	09.8	05.2	
	−1.0		−00.3	−06.8	−21.9	−00.4	03.2	19.8	06.0	07.9	
	−1.5		−00.2	−06.9	−07.9	−02.6	−00.7	17.6	08.0	04.0	
	−2.0		−00.1	−04.0	−16.1	01.1	01.8	14.4	03.7	05.9	
	−2.5			−02.9	−15.4		00.3	14.7	02.2	03.2	
	−3.0			−02.6	−17.1	00.7	−00.6	18.0	02.7	01.7	
	−3.5			−02.8	−16.1	01.1	−03.5	19.1	03.9	02.2	
	−4.0			−02.9	−14.9	03.7	−04.2	16.0	03.3	01.3	
Aft	−4.5			−01.4	−11.3	04.5	−03.9	16.6	01.8		
	−5.0			−00.2	−07.9	03.6	−03.0	14.8			
	−5.5				−02.7	01.0	−00.7	06.6			
	−6.0					00.2		01.0			
	−6.5							00.1			
	−7.0										
	−7.5										
	−8.0										
	−8.5										
	−9.0										

40 × 14 Commercial Airplane Tire Footprint Force Data

[Vertical load = 30 000 lb; tire pressure = 155 psi]

Circumferential position		Lateral force, lb, at—									
		Left of centerline, in.					Right of centerline, in.				
Location	in.	−6.12	−4.76	−3.40	−2.04	−0.68	0.68	2.04	3.40	4.76	6.12
	9.0										
	8.5							01.9			
	8.0			00.3	−04.7	02.1	−00.9	12.6	00.3		
	7.5			−00.2	−06.7	03.1	−01.3	10.9	05.8	04.8	
	7.0		−01.4	00.4	−07.0	03.5	−01.6	12.6	05.3	06.3	
	6.5		−05.3	−03.9	−07.3	03.1	−01.1	12.8	08.3	10.9	
	6.0		−08.2	−05.7	−07.1	03.2	−00.6	14.1	11.5	13.4	
	5.5		−13.0	−09.3	−10.2	02.9	−01.6	17.3	13.2	16.6	
	5.0		−13.9	−12.6	−13.1	04.9	−01.9	20.2	13.8	17.1	
Forward	4.5		−15.0	−16.4	−15.5	04.3	−02.1	25.7	15.8	21.1	
	4.0		−16.2	−17.4	−17.2	05.1	−02.2	25.9	14.9	23.3	
	3.5		−17.0	−17.1	−17.4	07.0	−00.4	29.3	16.6	25.3	
	3.0		−16.3	−16.2	−15.9	06.0	01.1	21.8	10.2	25.2	
	2.5		−15.7	−15.8	−12.9	04.0	03.7	19.9	13.3	25.2	
	2.0		−16.0	−14.3	−12.9	−00.4	02.2	18.1	16.6	23.6	
	1.5		−14.8	−12.9	−13.8	−03.6	02.1	23.3	17.9	25.4	
	1.0		−16.0	−12.3	−17.2	−04.0	02.7	27.8	13.3	25.3	
	0.5		−16.1	−12.7	−16.7	−04.0	06.1	22.3	11.4	23.2	
Center	0.0		−16.8	−14.8	−21.0	−07.0	01.0	18.8	10.7	24.1	
	−0.5		−13.9	−12.4	−15.1	−05.3	−01.3	25.0	16.0	23.7	
	−1.0		−11.5	−11.4	−21.3	−01.7	00.7	19.3	08.2	26.0	
	−1.5		−13.3	−12.3	−08.6	−05.8	−05.9	19.8	12.2	21.8	
	−2.0		−11.2	−09.8	−16.8	00.3	−01.6	14.2	05.4	27.5	
	−2.5		−10.4	−09.0	−17.1	−00.1	−03.8	14.9	04.3	23.9	
	−3.0		−11.5	−11.2	−19.5	01.3	−05.3	19.3	10.5	19.7	
	−3.5		−08.6	−11.7	−17.3	01.1	−07.7	24.1	12.3	22.0	
	−4.0		−08.4	−11.7	−14.0	02.4	−05.8	19.3	16.5	26.4	
Aft	−4.5		−08.6	−14.3	−14.3	00.4	−06.0	18.5	13.1	23.3	
	−5.0		−08.0	−13.5	−12.7	01.4	−04.5	19.7	12.6	21.4	
	−5.5		−10.3	−13.5	−14.4	02.0	−05.4	18.8	11.4	13.3	
	−6.0		−02.1	−08.5	−09.1	02.7	−03.5	12.9	07.1	14.1	
	−6.5			−04.1	−11.6	00.8	−04.2	13.7	01.8	05.6	
	−7.0			−00.8	−10.7	00.1	−03.2	12.1	03.0	02.3	
	−7.5			01.1	−08.2	00.2	−03.0	08.4	00.2	00.1	
	−8.0				−05.0	−00.7	−01.2	05.7	00.1		
	−8.5				−03.1	−00.5	−01.2	03.3			
	−9.0										

40 × 14 Commercial Airplane Tire Footprint Force Data

[Vertical load = 2000 lb; tire pressure = 170 psi]

Circumferential position		Lateral force, lb, at—									
		Left of centerline, in.					Right of centerline, in.				
Location	in.	−6.12	−4.76	−3.40	−2.04	−0.68	0.68	2.04	3.40	4.76	6.12
	9.0										
	8.5										
	8.0										
	7.5										
	7.0										
	6.5										
	6.0										
	5.5										
	5.0										
Forward	4.5										
	4.0							00.5			
	3.5							00.4			
	3.0							00.2			
	2.5					−00.1	−00.2	00.1			
	2.0				−00.1	00.4	−02.8	02.7			
	1.5				−00.4	00.5	−00.3	08.1			
	1.0				−01.9	−00.8	00.9	07.1			
	0.5				−01.2	00.4	04.6	08.1			
Center	0.0				−05.7	−01.7	−01.5	05.5			
	−0.5				01.4	−00.9	00.5	−04.6			
	−1.0				00.1	−00.4	00.6	−04.5			
	−1.5					−00.2	−01.2	−02.4			
	−2.0					00.1	−00.2	−00.9			
	−2.5										
	−3.0										
	−3.5										
	−4.0										
Aft	−4.5										
	−5.0										
	−5.5										
	−6.0										
	−6.5										
	−7.0										
	−7.5										
	−8.0										
	−8.5										
	−9.0										

40 × 14 Commercial Airplane Tire Footprint Force Data

[Vertical load = 16 000 lb; tire pressure = 170 psi]

Circumferential position		Lateral force, lb, at—									
		Left of centerline, in.					Right of centerline, in.				
Location	in.	−6.12	−4.76	−3.40	−2.04	−0.68	0.68	2.04	3.40	4.76	6.12
	9.0										
	8.5										
	8.0										
	7.5										
	7.0										
	6.5										
	6.0							−00.3			
	5.5				01.9	01.5	−00.1	−01.6			
	5.0				−05.2	00.9	−01.0	08.3	−00.4		
Forward	4.5			01.6	−12.6	−01.5	−02.3	18.4	01.9		
	4.0			00.1	−16.0	00.4	00.1	21.7	02.5		
	3.5			−04.2	−19.5	04.8	06.5	25.6	04.5	01.7	
	3.0			−04.6	−22.8	03.1	06.5	31.5	10.9	03.5	
	2.5			−05.1	−21.2	00.8	05.0	34.2	12.2	03.9	
	2.0			−04.5	−21.4	−02.3	01.2	32.0	10.9	05.9	
	1.5		−00.1	−05.0	−23.4	−03.8	03.6	32.8	14.5	06.4	
	1.0		−00.2	−06.0	−18.1	−04.9	03.9	19.5	12.7	07.0	
	0.5		−00.1	−06.0	−23.7	−02.2	07.2	24.5	14.7	07.2	
Center	0.0		−01.8	−07.6	−24.6	−03.8	01.2	25.7	06.5	02.2	
	−0.5		−00.4	−05.9	15.3	−03.0	03.5	−19.8	05.1	03.6	
	−1.0		−00.1	−03.9	22.3	−02.6	03.4	−20.0	05.1	03.5	
	−1.5		−00.1	−02.6	21.7	−02.2	01.1	−16.7	04.4	02.3	
	−2.0		−00.1	−02.5	19.4	−00.4	01.2	−17.3	03.7	03.1	
	−2.5			−02.9	10.9	−01.2	−01.2	−15.8	02.4	02.2	
	−3.0			−02.1	11.5	−03.6	−04.8	−12.7	02.0		
	−3.5			−01.0	09.7	−00.5	−03.8	−15.1	02.2		
	−4.0			−00.6	11.8	03.8	−03.3	−16.8	−01.8		
Aft	−4.5			00.6	09.7	04.7	−01.9	−13.3	−00.1		
	−5.0				06.3	03.0	−01.9	−11.1	00.4		
	−5.5				02.9	01.2	−00.7	−06.6	00.1		
	−6.0				00.3			−01.3			
	−6.5				00.1			−00.2			
	−7.0							−00.1			
	−7.5										
	−8.0										
	−8.5										
	−9.0										

40 × 14 Commercial Airplane Tire Footprint Force Data

[Vertical load = 30 000 lb; tire pressure = 170 psi]

Circumferential position		Lateral force, lb, at—									
		Left of centerline, in.					Right of centerline, in.				
Location	in.	−6.12	−4.76	−3.40	−2.04	−0.68	0.68	2.04	3.40	4.76	6.12
	9.0										
	8.5										
	8.0										
	7.5				01.6	00.1	−00.3	−02.6	−00.2		
	7.0			01.5	09.0	−00.4	−01.2	−06.9	−00.8		
	6.5			01.3	07.7	−00.2	−02.0	−10.4			
	6.0		−01.1	−02.6	08.7	−00.3	−01.6	−13.4	01.8	06.0	
	5.5		−03.4	−06.0	09.1	01.4	−01.3	−15.3	10.2	14.9	
	5.0		−05.3	−09.1	−15.6	03.2	−01.4	26.4	18.6	20.4	
Forward	4.5		−13.5	−14.1	−16.8	04.8	−01.5	33.9	15.7	14.7	
	4.0		−09.7	−14.6	−21.7	07.8	01.0	28.2	18.7	18.3	
	3.5		−07.0	−12.9	−22.7	10.1	06.9	28.8	23.1	26.4	
	3.0		−10.5	−14.1	−24.9	08.3	06.6	36.6	23.7	27.9	
	2.5		−10.7	−13.1	−23.3	04.0	04.9	30.8	19.8	27.8	
	2.0		−07.4	−09.0	−22.6	−00.6	01.9	37.3	23.2	30.9	
	1.5		−10.0	−10.4	−23.7	−03.0	04.3	31.8	19.6	28.0	
	1.0		−12.6	−11.3	−19.1	−05.5	04.3	18.8	16.3	27.9	
	0.5		−10.3	−13.1	−21.0	−03.0	07.5	33.0	19.6	26.9	
Center	0.0		−19.4	−17.8	−23.6	−05.1	01.0	31.7	15.8	17.5	
	−0.5		−10.1	−10.5	16.6	−04.4	04.1	−21.4	08.7	17.1	
	−1.0		−09.7	−09.3	23.0	−03.9	02.3	−22.4	09.0	16.5	
	−1.5		−11.1	−08.6	23.5	−03.1	−00.7	−20.7	08.6	14.6	
	−2.0		−08.4	−10.5	15.2	−02.4	−03.3	−20.5	08.2	16.7	
	−2.5		−07.3	−09.8	10.5	−02.7	−07.9	−19.9	08.0	17.4	
	−3.0		−11.3	−11.5	10.6	−03.9	−07.5	−16.1	07.3	12.5	
	−3.5		−11.1	−13.0	06.1	01.3	−07.0	−18.5	07.3	09.6	
	−4.0		−06.6	−11.2	19.7	07.7	−06.0	−20.6	09.7	13.9	
Aft	−4.5		−07.7	−13.0	16.7	10.6	−04.4	−19.1	08.6	11.6	
	−5.0		−07.9	−13.1	11.7	07.7	−05.2	−19.0	11.1	11.6	
	−5.5		−05.1	−08.4	11.1	05.1	−05.5	−14.7	09.3	09.8	
	−6.0		−00.6	−05.3	09.2	03.8	−03.9	−12.3	04.7	09.2	
	−6.5			−02.3	07.6	02.3	−02.3	−12.5	02.1	03.5	
	−7.0			00.9	08.7	00.6	−02.5	−09.9	00.6	00.4	
	−7.5				05.6	−00.1	−03.5	−05.2	00.4		
	−8.0				00.7	−00.2	−00.3	−01.9	00.1		
	−8.5										
	−9.0										

40 × 14 Commercial Airplane Tire Footprint Force Data

[Vertical load = 2000 lb; tire pressure = 140 psi]

Circumferential position		Drag force, lb, at—									
		Left of centerline, in.					Right of centerline, in.				
Location	in.	−6.12	−4.76	−3.40	−2.04	−0.68	0.68	2.04	3.40	4.76	6.12
	9.0										
	8.5										
	8.0										
	7.5										
	7.0										
	6.5										
	6.0										
	5.5										
	5.0										
Forward	4.5										
	4.0										
	3.5						00.1	−00.2			
	3.0						00.6	−00.2			
	2.5					01.3	01.5	−00.2			
	2.0					−03.4	−05.3	−03.1			
	1.5				00.3	04.2	02.8	01.7			
	1.0				00.3	02.4	03.1	01.8			
	0.5				00.6	−01.1	00.2	00.2			
Center	0.0				−00.4	00.3	−00.2	−01.2			
	−0.5				00.6	−00.2	−00.6	00.9			
	−1.0				−00.1	−01.7	−04.8	00.6			
	−1.5					−00.1	00.6	00.2			
	−2.0										
	−2.5										
	−3.0										
	−3.5										
	−4.0										
Aft	−4.5										
	−5.0										
	−5.5										
	−6.0										
	−6.5										
	−7.0										
	−7.5										
	−8.0										
	−8.5										
	−9.0										

40 × 14 Commercial Airplane Tire Footprint Force Data

[Vertical load = 16 000 lb; tire pressure = 140 psi]

Circumferential position		Drag force, lb, at –									
		Left of centerline, in.					Right of centerline, in.				
Location	in.	−6.12	−4.76	−3.40	−2.04	−0.68	0.68	2.04	3.40	4.76	6.12
	9.0										
	8.5										
	8.0										
	7.5										
	7.0										
	6.5				−01.2	−03.2	−04.0	−07.5			
	6.0			−00.3	−06.6	−10.2	−10.3	−11.1	−01.7		
	5.5			−02.5	−08.9	−11.5	−11.4	−14.6	−04.1		
	5.0			−07.0	−12.6	−11.8	−11.6	−12.2	−05.9		
Forward	4.5			−07.2	−08.6	−12.8	−12.8	−11.4	−07.5		
	4.0			−05.6	−04.9	−11.9	−12.5	−09.9	−07.5		
	3.5			−03.3	−00.4	−10.7	−09.7	01.9	−04.0		
	3.0		−00.7	−00.7	07.4	−01.3	−04.8	03.4			
	2.5		−00.4	−00.1	06.6	08.5	08.2	08.6	03.9		
	2.0		−00.3	02.7	08.4	01.7	−00.9	09.4	03.4	00.7	
	1.5		00.2	03.4	11.5	10.7	07.6	12.5	05.0	00.5	
	1.0			02.4	08.7	11.7	12.1	09.5	04.2	00.4	
	0.5		00.2	03.4	08.4	09.2	10.6	08.2	05.2	00.4	
Center	0.0		00.7	04.6	06.5	09.1	09.1	03.7	05.0	00.3	
	−0.5		01.0	04.7	07.4	06.5	06.6	05.9	03.6	00.3	
	−1.0		00.3	03.5	07.1	04.7	04.2	06.0	05.4	01.0	
	−1.5		00.8	05.3	06.4	01.5	05.7	03.9	04.3	00.4	
	−2.0		00.4	04.3	03.2	03.1	06.3	01.4	04.8	00.4	
	−2.5		00.7	03.6	−00.3	00.8	06.0	−01.6	02.4	00.2	
	−3.0		00.2	01.7	−02.7	−04.3	−02.1	−05.0	−00.3		
	−3.5		00.1	01.4	01.8	03.1	07.8	−02.1	00.9		
	−4.0			02.9	00.6	06.7	13.4	00.5	04.5		
Aft	−4.5			04.0	05.9	07.1	13.6	02.7	04.0		
	−5.0			02.9	06.1	09.2	12.9	05.2	03.0		
	−5.5			00.8	05.4	09.1	11.6	08.4	00.9		
	−6.0				02.6	02.2	03.1	05.2			
	−6.5					00.1	00.2	00.4			
	−7.0										
	−7.5										
	−8.0										
	−8.5										
	−9.0										

40 × 14 Commercial Airplane Tire Footprint Force Data

[Vertical load = 30 000 lb; tire pressure = 140 psi]

Circumferential position		Drag force, lb, at—									
		Left of centerline, in.					Right of centerline, in.				
Location	in.	−6.12	−4.76	−3.40	−2.04	−0.68	0.68	2.04	3.40	4.76	6.12
	9.0										
	8.5										
	8.0			−06.5	−11.5	−12.7	−13.1	−14.5	−08.2	−00.6	
	7.5			−11.8	−16.0	−15.5	−15.0	−18.1	−12.5	−01.4	
	7.0		−03.8	−13.8	−16.6	−14.4	−13.3	−20.8	−10.0	−02.6	
	6.5		−06.9	−16.7	−16.4	−14.3	−13.8	−19.2	−10.6	−04.6	
	6.0		−10.7	−17.7	−17.7	−14.7	−14.2	−20.9	−13.0	−06.5	
	5.5		−10.3	−15.3	−16.6	−14.3	−13.4	−18.5	−09.8	−06.2	
	5.0		−09.0	−16.6	−15.7	−13.5	−11.7	−18.3	−08.8	−04.7	
Forward	4.5		−08.1	−14.2	−13.3	−13.5	−12.7	−14.3	−07.2	−03.6	
	4.0		−06.9	−09.8	−04.3	−13.7	−13.8	−13.0	−05.9	−02.0	
	3.5		−06.2	−04.9	01.2	−12.5	−10.3	−00.3	−02.0	−01.7	
	3.0		−04.8	−01.0	06.9	−09.7	−11.3	−07.1	−01.7		
	2.5		−05.4		07.3	10.5	09.8	08.5	05.5	01.3	
	2.0		−00.8	03.8	08.6	01.5	−00.6	10.1	06.1	02.7	
	1.5		00.8	05.4	13.4	03.6	−01.4	13.0	05.5	01.9	
	1.0		01.9	05.1	11.9	11.3	09.5	13.4	07.3	02.3	
	0.5		01.2	05.3	10.7	12.1	12.3	12.1	07.5	01.9	
Center	0.0		01.0	04.8	08.1	11.3	11.8	06.4	05.1	01.0	
	−0.5		00.8	04.7	07.7	08.2	09.6	05.8	02.8	00.9	
	−1.0		01.0	03.6	07.0	10.3	09.4	06.6	06.1	01.7	
	−1.5		01.6	05.7	06.2	12.2	14.4	05.0	05.8	02.1	
	−2.0		03.0	05.3	03.2	04.4	11.5	03.0	05.4	03.2	
	−2.5		00.8	03.5	−02.0		07.5	−01.1	01.4	01.5	
	−3.0		03.3	03.7	−02.4	−02.9	00.1	−03.8	−00.4	01.1	
	−3.5		02.9	03.3	02.7	14.4	15.2	01.1	05.0	03.9	
	−4.0		04.8	05.2	02.3	15.9	14.5	07.5	06.6	03.3	
Aft	−4.5		06.3	10.4	10.2	14.5	14.3	06.3	06.1	04.2	
	−5.0		07.3	13.5	15.7	15.2	14.5	14.3	09.4	04.9	
	−5.5		09.6	14.9	18.1	14.8	15.0	21.9	13.1	05.3	
	−6.0		09.3	17.9	19.9	15.1	15.5	22.4	12.9	05.4	
	−6.5		08.3	18.2	19.5	15.2	15.4	22.5	13.2	04.4	
	−7.0		00.8	15.4	16.1	14.6	15.9	21.0	14.6	03.6	
	−7.5			12.4	13.4	15.9	14.9	18.7	09.8	02.5	
	−8.0			04.7	12.8	11.6	11.6	15.6	04.5		
	−8.5										
	−9.0										

40 × 14 Commercial Airplane Tire Footprint Force Data

[Vertical load = 2000 lb; tire pressure = 155 psi]

Circumferential position		Drag force, lb, at—									
		Left of centerline, in.					Right of centerline, in.				
Location	in.	−6.12	−4.76	−3.40	−2.04	−0.68	0.68	2.04	3.40	4.76	6.12
	9.0										
	8.5										
	8.0										
	7.5										
	7.0										
	6.5										
	6.0										
	5.5										
	5.0										
Forward	4.5										
	4.0										
	3.5						00.9				
	3.0						00.4	−00.2			
	2.5					00.6	01.2	−00.1			
	2.0					01.4	01.6	00.1			
	1.5				00.5	02.9	−00.3	01.5			
	1.0				01.0	04.5	04.3	01.8			
	0.5				01.4	−01.7	−08.7	00.8			
Center	0.0				00.9	00.3	−05.5	01.6			
	−0.5				00.2	−01.3	−01.8	−01.0			
	−1.0					−00.9	−02.1	−01.5			
	−1.5					−00.5	−01.4	−00.2			
	−2.0						−00.2				
	−2.5										
	−3.0										
	−3.5										
	−4.0										
Aft	−4.5										
	−5.0										
	−5.5										
	−6.0										
	−6.5										
	−7.0										
	−7.5										
	−8.0										
	−8.5										
	−9.0										

40 × 14 Commercial Airplane Tire Footprint Force Data

[Vertical load = 16 000 lb; tire pressure = 155 psi]

Circumferential position		Drag force, lb, at—									
		Left of centerline, in.					Right of centerline, in.				
Location	in.	−6.12	−4.76	−3.40	−2.04	−0.68	0.68	2.04	3.40	4.76	6.12
	9.0										
	8.5										
	8.0										
	7.5										
	7.0							−01.0			
	6.5				−00.4	−01.7	−02.2	−03.8			
	6.0				−05.3	−08.7	−08.3	−09.2	−00.6		
	5.5			−01.4	−08.9	−12.0	−09.9	−12.5	−02.7		
	5.0			−04.7	−12.0	−13.2	−10.6	−15.1	−06.1		
Forward	4.5			−05.6	−11.7	−13.5	−10.6	−12.1	−06.2		
	4.0			−04.2	−05.2	−11.4	−09.8	−04.8	−04.5	−00.1	
	3.5			−02.5	00.6	−02.9	−04.0	−00.4	−02.7	−00.1	
	3.0			00.7	06.9	06.5	04.5	04.9	01.1	00.1	
	2.5			01.6	10.7	09.1	05.0	11.0	02.7	00.2	
	2.0			03.3	12.1	14.5	11.6	12.2	03.4	00.3	
	1.5			04.3	13.4	14.3	11.5	13.9	06.7	00.6	
	1.0			04.0	11.7	14.1	15.7	10.7	06.5	00.1	
	0.5		00.3	05.1	10.8	11.1	05.6	11.7	06.8	00.4	
Center	0.0		00.3	04.1	08.6	10.3	06.2	09.7	05.8	00.4	
	−0.5		00.4	04.6	07.4	06.9	07.5	06.9	06.1	00.6	
	−1.0		00.2	03.0	08.3	02.1	03.0	02.5	03.3	00.2	
	−1.5		00.1	02.6	−02.3	−01.3	02.0	−00.4	03.5	00.3	
	−2.0			01.3	02.3	−03.1	−02.6	−02.3	00.8	00.4	
	−2.5			01.1	−01.6	−05.0	−03.0	−04.2	−00.2	00.1	
	−3.0			−00.7	−00.9	−03.1	02.6	−03.9	00.7	−00.1	
	−3.5			00.3	02.7	−02.9	00.7	−04.7	−01.5		
	−4.0			00.4	05.0	01.3	06.1		01.1		
Aft	−4.5			02.6	04.4	05.7	11.7	04.9	02.0		
	−5.0			01.6	04.4	06.2	10.4	07.7	01.7		
	−5.5			−00.2	03.1	03.0	03.9	05.4	−00.3		
	−6.0					00.4	00.4	02.1	−00.2		
	−6.5						00.2	−00.1			
	−7.0										
	−7.5										
	−8.0										
	−8.5										
	−9.0										

40 × 14 Commercial Airplane Tire Footprint Force Data

[Vertical load = 30 000 lb; tire pressure = 155 psi]

Circumferential position		Drag force, lb, at—									
		Left of centerline, in.					Right of centerline, in.				
Location	in.	−6.12	−4.76	−3.40	−2.04	−0.68	0.68	2.04	3.40	4.76	6.12
	9.0										
	8.5							−01.6			
	8.0			−00.5	−09.5	−09.0	−08.4	−11.3	−02.2		
	7.5			−11.9	−17.9	−12.2	−12.5	−19.7	−13.9	−01.7	
	7.0		−01.3	−15.5	−19.2	−15.8	−13.5	−22.7	−14.2	−02.9	
	6.5		−06.0	−20.5	−19.3	−14.2	−12.2	−22.7	−13.5	−04.6	
	6.0		−09.5	−21.5	−21.5	−15.4	−12.5	−25.0	−14.4	−06.3	
	5.5		−10.3	−20.5	−20.1	−14.3	−11.8	−21.6	−12.3	−06.4	
	5.0		−09.2	−19.8	−20.5	−14.7	−11.1	−21.8	−12.3	−05.0	
Forward	4.5		−07.8	−14.9	−15.8	−13.3	−11.0	−20.2	−12.0	−04.3	
	4.0		−06.3	−08.1	−06.3	−14.7	−11.6	−13.2	−07.8	−02.5	
	3.5		−03.8	−02.5	04.7	−13.7	−10.5	−07.6	−02.4	−00.6	
	3.0		−01.7	01.9	10.1	−08.8	−09.4	06.2	05.9	00.5	
	2.5		00.4	04.7	14.2	−01.5	−05.9	12.8	06.4	01.1	
	2.0		01.2	06.6	15.0	06.5	02.1	15.3	06.8	01.9	
	1.5		01.4	07.4	16.2	11.8	07.2	15.5	08.6	02.2	
	1.0		01.1	06.9	15.5	14.7	16.7	14.0	09.6	02.0	
	0.5		00.9	06.1	12.2	13.4	08.7	15.1	09.3	02.4	
Center	0.0		00.9	04.1	08.3	12.6	09.4	12.6	07.8	01.6	
	−0.5		01.5	06.0	09.5	14.3	14.1	11.9	07.4	01.6	
	−1.0		01.1	03.6	08.6	11.6	13.0	05.7	05.6	02.0	
	−1.5		01.2	02.8	−02.9	10.5	13.1	02.4	05.5	02.2	
	−2.0			00.4	01.0	08.6	11.2	−03.5	−00.3	02.2	
	−2.5		01.4	00.7	01.5	12.7	12.4	−03.5	−01.7	02.5	
	−3.0		02.2	−00.7	02.0	12.9	11.2	−01.7	02.1	00.8	
	−3.5		−00.2	−01.2	05.4	18.8	16.3	08.9	02.4	01.7	
	−4.0		04.2	02.7	08.2	18.0	15.3	12.9	09.9	03.6	
Aft	−4.5		06.4	07.8	12.0	16.8	14.8	18.0	11.7	04.2	
	−5.0		06.9	12.4	16.0	14.2	13.1	20.7	14.0	05.0	
	−5.5		08.4	17.6	21.2	15.1	14.3	22.9	13.8	05.0	
	−6.0		01.7	11.6	15.1	16.6	14.3	20.9	12.4	04.5	
	−6.5			11.8	16.9	15.6	14.1	23.3	12.3	02.1	
	−7.0			09.8	16.5	13.7	12.7	21.4	11.2	00.9	
	−7.5			04.1	11.7	11.0	10.8	15.2	04.8		
	−8.0				06.3	04.0	04.3	09.7	00.4		
	−8.5				03.3	02.8	02.4	09.8			
	−9.0										

40 × 14 Commercial Airplane Tire Footprint Force Data

[Vertical load = 2000 lb; tire pressure = 170 psi]

Circumferential position		Drag force, lb, at —									
		Left of centerline, in.					Right of centerline, in.				
Location	in.	−6.12	−4.76	−3.40	−2.04	−0.68	0.68	2.04	3.40	4.76	6.12
	9.0										
	8.5										
	8.0										
	7.5										
	7.0										
	6.5										
	6.0										
	5.5										
	5.0										
Forward	4.5										
	4.0										
	3.5						00.1				
	3.0						00.2				
	2.5					00.1	01.0				
	2.0					01.9	01.2	00.1			
	1.5				00.3	04.3	01.3	03.3			
	1.0				01.3	03.5	02.2	−00.4			
	0.5				00.4	02.6	01.0	02.1			
Center	0.0				00.6	00.4	00.5	00.1			
	−0.5				−00.6	−01.5	−02.5	−01.4			
	−1.0				−00.1	−02.5	−02.8	−02.4			
	−1.5						−00.1	00.1			
	−2.0				−00.1	−00.9	−02.9	−01.1			
	−2.5					−00.1					
	−3.0				−00.1		−00.1				
	−3.5					−02.6	−03.4	−02.1			
	−4.0						−00.1	00.1			
Aft	−4.5										
	−5.0										
	−5.5										
	−6.0										
	−6.5										
	−7.0										
	−7.5										
	−8.0										
	−8.5										
	−9.0										

40 × 14 Commercial Airplane Tire Footprint Force Data

[Vertical load = 16 000 lb; tire pressure = 170 psi]

Circumferential position		Drag force, lb, at—									
		Left of centerline, in.					Right of centerline, in.				
Location	in.	−6.12	−4.76	−3.40	−2.04	−0.68	0.68	2.04	3.40	4.76	6.12
	9.0										
	8.5										
	8.0										
	7.5										
	7.0										
	6.5										
	6.0							−00.8			
	5.5				−01.8	−04.6	−04.7	−04.0			
	5.0			−01.0	−06.2	−09.7	−10.8	−12.2	−01.1		
Forward	4.5			−03.2	−08.6	−12.3	−10.1	−10.3	−03.7		
	4.0			−02.4	−04.5	−07.5	−04.9	−06.5	−04.9		
	3.5			−00.9	00.4	00.2	01.7	−01.5	−03.0	−00.3	
	3.0			00.4	05.9	12.0	10.6	03.7	−01.8		
	2.5			02.2	09.8	17.7	14.4	06.6	−00.3	00.3	
	2.0			04.1	11.2	17.3	14.0	06.2	01.9	00.7	
	1.5			05.8	11.2	16.6	13.4	10.1	04.3	00.8	
	1.0			05.5	12.5	15.8	13.3	11.3	05.9	00.7	
	0.5			04.4	09.5	14.8	12.2	09.5	04.9	00.6	
Center	0.0		00.4	04.0	07.5	10.6	11.2	08.4	06.1	00.4	
	−0.5		00.1	03.3	04.9	05.6	05.1	06.0	05.3	00.5	
	−1.0			02.9	05.6	−01.3	−00.9	01.1	03.8	00.4	
	−1.5			00.6	−09.7	−09.3	−05.2	−07.0	−00.8	−00.1	
	−2.0			01.2	01.2	−06.7	−06.6	−04.6	02.4	00.2	
	−2.5			00.5	−04.3	−06.5	−04.1	−04.8	01.7		
	−3.0			−00.5	−07.0	−07.0	−01.1	−06.5	01.1		
	−3.5			02.0	03.2	−05.5	−05.1	−02.3	02.0		
	−4.0			01.2	−03.0	−06.7	−02.8	−05.9	00.3		
Aft	−4.5			01.8	00.9	−00.5	01.7	−00.1	01.5		
	−5.0				03.8	03.5	05.0	04.0	00.9		
	−5.5				03.5	03.8	04.4	05.4	−00.3		
	−6.0				00.4	00.5	00.9	03.1	−00.1		
	−6.5						00.1				
	−7.0										
	−7.5										
	−8.0										
	−8.5										
	−9.0										

40 × 14 Commercial Airplane Tire Footprint Force Data

[Vertical load = 30 000 lb; tire pressure = 170 psi]

Circumferential position		Drag force, lb, at—									
		Left of centerline, in.					Right of centerline, in.				
Location	in.	−6.12	−4.76	−3.40	−2.04	−0.68	0.68	2.04	3.40	4.76	6.12
	9.0										
	8.5										
	8.0										
	7.5				−03.0	−04.0	−04.1	−06.1			
	7.0			−03.7	−08.7	−10.8	−10.2	−13.7	−04.1		
	6.5			−06.2	−13.2	−12.3	−11.4	−17.4	−06.6	−00.1	
	6.0		−01.3	−14.7	−17.4	−15.0	−13.7	−20.6	−14.3	−02.7	
	5.5		−02.1	−13.3	−18.9	−16.6	−14.8	−19.8	−14.2	−05.2	
	5.0		−04.2	−14.3	−21.1	−17.3	−13.3	−22.5	−15.2	−04.6	
Forward	4.5		−06.0	−11.9	−13.6	−16.7	−12.8	−18.9	−09.9	−02.8	
	4.0		−03.0	−05.7	−04.5	−12.6	−12.9	−09.3	−08.9	−01.7	
	3.5		−01.4	−00.3	03.9	−01.1	−01.8	−04.8	−06.8	−01.3	
	3.0		00.1	03.0	10.9	11.3	07.7	00.8	−03.8	−00.6	
	2.5		00.6	05.0	14.0	18.9	15.1	04.1	−02.5		
	2.0		01.5	06.5	12.2	19.7	16.2	01.6	00.4	01.3	
	1.5		00.9	07.6	13.0	18.4	15.0	04.4	−01.0	01.1	
	1.0		01.0	07.2	15.1	17.2	14.5	15.4	09.2	01.1	
	0.5		00.6	06.3	11.6	17.2	13.6	07.1	01.3	01.1	
Center	0.0		01.1	05.9	10.0	15.7	16.2	11.2	05.9	01.1	
	−0.5		02.0	05.0	07.7	10.3	10.1	10.1	08.1	01.9	
	−1.0		01.7	04.2	07.4	02.9	08.7	04.1	05.9	01.5	
	−1.5		02.2	01.5	−14.2	−01.2	08.6	−05.0	−00.7	02.1	
	−2.0		00.8	01.2	−01.2	02.6	08.0	−03.9	02.5	01.1	
	−2.5			−00.9	−06.8	05.7	12.6	−02.4	01.4	00.8	
	−3.0		01.5	−02.1	−08.6	−01.7	08.4	−06.7	00.6	00.6	
	−3.5		01.3	02.8	05.3	−00.7	06.7		03.6	01.3	
	−4.0		02.7	02.8	02.6	04.8	13.9	−01.9	02.6	01.8	
Aft	−4.5		03.4	07.7	10.4	11.0	14.2	06.6	07.0	02.4	
	−5.0		04.6	12.5	19.2	15.2	15.7	16.4	10.2	03.0	
	−5.5		03.9	14.7	20.3	15.7	15.8	23.1	14.3	03.0	
	−6.0			11.5	18.1	15.3	14.9	23.3	13.0	01.4	
	−6.5		00.8	12.7	18.5	15.7	15.1	24.9	15.0	02.9	
	−7.0				08.7	07.9	09.1	10.0	01.7		
	−7.5			07.2	13.6	13.9	13.6	16.2	08.0		
	−8.0				01.5	01.1	01.6	04.5			
	−8.5										
	−9.0										

32 × 8.8 Space Shuttle Orbiter Nose Gear Tire Footprint Force Data

[Vertical load = 2000 lb; tire pressure = 300 psi]

Circumferential position		Vertical force, lb, at--									
		Left of centerline, in.					Right of centerline, in.				
Location	in.	−6.12	−4.76	−3.40	−2.04	−0.68	0.68	2.04	3.40	4.76	6.12
	9.0										
	8.5										
	8.0										
	7.5										
	7.0										
	6.5										
	6.0										
	5.5										
	5.0										
Forward	4.5										
	4.0										
	3.5										
	3.0										
	2.5					06.8	01.0				
	2.0					53.4	23.9				
	1.5					104.2	69.8				
	1.0					119.2	95.7				
	0.5					123.4	103.2				
Center	0.0					125.9	106.4				
	−0.5					128.0	110.5				
	−1.0					117.6	97.5				
	−1.5					93.5	67.6				
	−2.0					40.4	19.1				
	−2.5					02.2	00.1				
	−3.0										
	−3.5										
	−4.0										
Aft	−4.5										
	−5.0										
	−5.5										
	−6.0										
	−6.5										
	−7.0										
	−7.5										
	−8.0										
	−8.5										
	−9.0										

32 × 8.8 Space Shuttle Orbiter Nose Gear Tire Footprint Force Data

[Vertical load = 15 000 lb; tire pressure = 300 psi]

Circumferential position		Vertical force, lb, at—									
		Left of centerline, in.					Right of centerline, in.				
Location	in.	−6.12	−4.76	−3.40	−2.04	−0.68	0.68	2.04	3.40	4.76	6.12
	9.0										
	8.5										
	8.0										
	7.5										
	7.0										
	6.5										
	6.0										
	5.5					09.7	04.4				
	5.0					86.0	75.0				
Forward	4.5				00.7	124.2	124.1	00.1			
	4.0				23.0	129.2	133.4	15.6			
	3.5				56.0	128.3	133.7	48.6			
	3.0				77.7	126.8	131.5	97.9			
	2.5				80.8	126.5	132.1	98.2			
	2.0				86.2	126.5	131.4	105.7			
	1.5				87.6	126.8	132.4	108.9			
	1.0				90.5	126.8	132.3	113.6			
	0.5				89.3	126.0	130.7	113.3			
Center	0.0				92.0	129.8	123.4	123.5			
	−0.5				91.5	129.8	123.8	121.3			
	−1.0				93.0	131.9	128.1	122.8			
	−1.5				92.7	131.6	127.1	122.2			
	−2.0				93.6	130.6	126.0	121.7			
	−2.5				91.0	130.6	126.5	115.6			
	−3.0				74.5	132.9	128.0	102.0			
	−3.5				55.9	132.1	127.2	79.4			
	−4.0				09.1	129.0	131.2	26.3			
Aft	−4.5				03.0	125.2	125.2	00.2			
	−5.0				00.1	92.2	80.6	00.1			
	−5.5					12.3	07.6				
	−6.0										
	−6.5										
	−7.0										
	−7.5										
	−8.0										
	−8.5										
	−9.0										

32 × 8.8 Space Shuttle Orbiter Nose Gear Tire Footprint Force Data

[Vertical load = 30 000 lb; tire pressure = 300 psi]

Circumferential position		Vertical force, lb, at—									
		Left of centerline, in.					Right of centerline, in.				
Location	in.	−6.12	−4.76	−3.40	−2.04	−0.68	0.68	2.04	3.40	4.76	6.12
	9.0										
	8.5										
	8.0					00.1	00.1				
	7.5					06.4	03.7				
	7.0				00.1	83.3	78.9				
	6.5				19.8	125.6	124.8	29.3			
	6.0				54.8	127.3	129.4	103.5			
	5.5			01.0	66.2	125.1	128.0	126.8			
	5.0			16.7	67.7	124.3	128.0	123.1			
Forward	4.5			40.9	70.4	125.5	127.6	121.8	01.2		
	4.0			60.8	74.1	126.0	128.0	120.0	10.6		
	3.5			78.4	80.0	126.5	128.6	119.6	24.0		
	3.0			94.8	80.4	126.7	127.6	117.4	39.2		
	2.5			99.4	84.3	126.5	128.4	118.4	49.4		
	2.0			104.9	87.8	126.4	128.0	116.6	62.2		
	1.5			109.2	88.8	127.4	129.5	116.5	67.4		
	1.0			108.8	91.9	126.8	129.6	117.0	78.3		
	0.5			108.6	91.0	126.5	128.0	116.0	81.8		
Center	0.0			106.6	92.3	129.8	121.7	120.6	90.4		
	−0.5			104.7	91.7	129.7	121.8	118.8	92.2		
	−1.0			102.2	93.6	131.2	125.3	117.7	90.4		
	−1.5			100.2	94.0	130.5	124.6	119.0	85.6		
	−2.0			94.9	95.5	129.2	123.4	120.9	79.3		
	−2.5			85.2	96.3	129.0	123.3	121.1	67.1		
	−3.0			71.9	91.7	130.2	123.8	120.6	51.4		
	−3.5			62.2	88.6	128.9	122.7	123.1	35.8		
	−4.0			03.6	112.1	123.8	129.1	66.7	76.1		
Aft	−4.5			43.6	78.8	125.4	127.8	123.5	01.6		
	−5.0			21.5	74.2	124.8	128.2	123.8			
	−5.5			01.3	83.4	123.9	124.8	123.6			
	−6.0				73.0	125.8	126.3	103.1			
	−6.5				33.5	122.6	123.0	24.9			
	−7.0				00.2	83.4	79.8				
	−7.5					11.1	09.8				
	−8.0										
	−8.5										
	−9.0										

32 × 8.8 Space Shuttle Orbiter Nose Gear Tire Footprint Force Data

[Vertical load = 2000 lb; tire pressure = 300 psi]

Circumferential position		Lateral force, lb, at --									
		Left of centerline, in.					Right of centerline, in.				
Location	in.	−6.12	−4.76	−3.40	−2.04	−0.68	0.68	2.04	3.40	4.76	6.12
	9.0										
	8.5										
	8.0										
	7.5										
	7.0										
	6.5										
	6.0										
	5.5										
	5.0										
Forward	4.5										
	4.0										
	3.5										
	3.0						−00.1				
	2.5					−00.2	−00.1				
	2.0					00.4	−02.0				
	1.5					−02.0	−04.2				
	1.0					−03.4	−01.7				
	0.5					−06.7	00.3				
Center	0.0					−08.1	02.2				
	−0.5					−08.7	03.4				
	−1.0					−03.3	−02.0				
	−1.5					00.5	−0.35				
	−2.0					00.8	−01.4				
	−2.5						00.1				
	−3.0										
	−3.5										
	−4.0										
Aft	−4.5										
	−5.0										
	−5.5										
	−6.0										
	−6.5										
	−7.0										
	−7.5										
	−8.0										
	−8.5										
	−9.0										

32 × 8.8 Space Shuttle Orbiter Nose Gear Tire Footprint Force Data

[Vertical load = 15 000 lb; tire pressure = 300 psi]

Circumferential position		Lateral force, lb, at—									
		Left of centerline, in.					Right of centerline, in.				
Location	in.	−6.12	−4.76	−3.40	−2.04	−0.68	0.68	2.04	3.40	4.76	6.12
	9.0										
	8.5										
	8.0										
	7.5										
	7.0										
	6.5										
	6.0					−00.1	00.1	00.1			
	5.5					−00.5	00.1	00.1			
	5.0					−04.6	−00.4				
Forward	4.5				00.1	−09.5	04.0				
	4.0				02.6	−10.4	07.8	−01.8			
	3.5				07.3	−10.9	10.1	−04.2			
	3.0				15.8	−11.9	11.6	−09.7			
	2.5				16.7	−12.6	13.0	−11.1			
	2.0				19.9	−12.9	13.9	−15.7			
	1.5				21.1	−14.2	15.3	−18.4			
	1.0				24.2	−13.6	17.3	−22.2			
	0.5				24.5	−15.4	18.0	−23.0			
Center	0.0				24.7	−17.1	17.2	−28.2			
	−0.5				24.2	−16.8	16.8	−27.4			
	−1.0				22.8	−15.5	15.9	−25.7			
	−1.5				21.7	−14.1	14.6	−24.8			
	−2.0				19.4	−12.8	13.1	−22.6			
	−2.5				16.2	−12.1	12.0	−19.0			
	−3.0				10.6	−11.7	10.9	−12.9			
	−3.5				06.6	−10.8	09.6	−09.2			
	−4.0				01.0	−07.8	13.1	−03.8			
Aft	−4.5				00.8	−09.1	04.2				
	−5.0				00.1	−05.7	−01.1				
	−5.5					−00.7	−00.1				
	−6.0										
	−6.5										
	−7.0										
	−7.5										
	−8.0										
	−8.5										
	−9.0										

32 × 8.8 Space Shuttle Orbiter Nose Gear Tire Footprint Force Data

[Vertical load = 30 000 lb; tire pressure = 300 psi]

Circumferential position		Lateral force, lb, at									
		Left of centerline, in.					Right of centerline, in.				
Location	in.	−6.12	−4.76	−3.40	−2.04	−0.68	0.68	2.04	3.40	4.76	6.12
	9.0										
	8.5										
	8.0										
	7.5					−00.6	00.1				
	7.0				−00.1	−05.2	02.0	00.1			
	6.5				03.4	−09.0	04.8	−04.7			
	6.0				10.4	−08.9	07.3	−13.0			
	5.5			−00.1	14.5	−09.1	08.0	−19.0			
	5.0		00.1	−02.5	16.4	−10.0	08.3	−20.3	00.1		
Forward	4.5		00.2	−07.5	18.7	−10.6	09.1	−22.8	00.2		
	4.0		00.2	−13.7	21.1	−10.6	10.1	−25.6	02.3		
	3.5		00.2	−17.9	23.6	−10.8	10.8	−26.1	05.1		
	3.0		00.2	−24.1	23.2	−11.3	12.7	−30.3	10.4		
	2.5		00.2	−26.7	25.2	−12.1	13.3	−28.6	10.7		
	2.0		00.3	−32.0	30.3	−12.6	14.4	−35.2	15.7		
	1.5		00.3	−34.8	30.3	−13.9	15.5	−35.2	16.6		
	1.0		00.2	−37.2	34.1	−13.4	17.7	−40.3	22.1		
	0.5		00.3	−37.7	34.2	−14.7	18.8	−42.8	24.5		
Center	0.0		00.1	−38.5	36.9	−16.0	18.7	−48.1	33.0		
	−0.5			−34.4	33.5	−15.3	18.4	−46.8	32.3		
	−1.0			−32.3	34.9	−13.6	18.1	−40.7	31.1		
	−1.5			−29.4	32.9	−12.5	16.4	−38.7	26.3		
	−2.0			−27.8	31.6	−11.4	15.0	−39.7	25.4		
	−2.5			−24.5	31.2	−10.8	13.9	−37.3	20.1		
	−3.0			−19.2	29.1	−10.5	13.8	−36.0	14.5		
	−3.5			−16.6	26.4	−09.9	12.3	−34.0	09.5		
	−4.0			−01.1	27.3	−10.1	14.0	−21.0	17.8		
Aft	−4.5			−08.2	19.9	−10.0	10.3	−29.7	00.6		
	−5.0			−04.3	17.4	−10.7	08.3	−22.5	00.1		
	−5.5			−00.3	17.7	−08.9	08.1	−21.9			
	−6.0			−00.1	13.6	−08.7	07.0	−14.2			
	−6.5				06.3	−07.4	04.8	−04.0			
	−7.0				00.1	−04.5	01.6	−00.1			
	−7.5					−00.9	00.2	−00.1			
	−8.0					−00.1	00.1	−00.1			
	−8.5										
	−9.0										

32 × 8.8 Space Shuttle Orbiter Nose Gear Tire Footprint Force Data

[Vertical load = 2000 lb; tire pressure = 300 psi]

Circumferential position		Drag force, lb, at—									
		Left of centerline, in.					Right of centerline, in.				
Location	in.	−6.12	−4.76	−3.40	−2.04	−0.68	0.68	2.04	3.40	4.76	6.12
	9.0										
	8.5										
	8.0										
	7.5										
	7.0										
	6.5										
	6.0										
	5.5										
	5.0										
Forward	4.5										
	4.0										
	3.5										
	3.0										
	2.5					−00.1					
	2.0					−02.1	−00.9				
	1.5					00.9	01.0				
	1.0					02.7	02.6				
	0.5					02.6	02.6				
Center	0.0					00.1	00.9				
	−0.5					02.4	02.5				
	−1.0					02.4	02.3				
	−1.5					−00.3					
	−2.0					−02.0	−00.9				
	−2.5					−00.2	−00.1				
	−3.0					−00.1	−00.1				
	−3.5										
	−4.0										
Aft	−4.5										
	−5.0										
	−5.5										
	−6.0										
	−6.5										
	−7.0										
	−7.5										
	−8.0										
	−8.5										
	−9.0										

32 × 8.8 Space Shuttle Orbiter Nose Gear Tire Footprint Force Data

[Vertical load = 15 000 lb; tire pressure = 300 psi]

Circumferential position		Drag force, lb, at—									
		Left of centerline, in.					Right of centerline, in.				
Location	in.	−6.12	−4.76	−3.40	−2.04	−0.68	0.68	2.04	3.40	4.76	6.12
Forward	9.0										
	8.5										
	8.0										
	7.5										
	7.0										
	6.5										
	6.0					−00.1	−00.1				
	5.5					−00.4	−00.4				
	5.0		00.2		−00.1	01.5	00.2	−00.1			
	4.5					10.5	08.8	−00.1			
	4.0		00.1		01.2	13.5	12.6	00.7			
	3.5			00.1	03.1	13.5	12.9	01.8			
	3.0		00.1	00.1	06.5	12.9	12.8	05.6			
	2.5		00.1		06.0	11.9	11.8	04.6			
	2.0		00.1	−00.1	05.8	10.7	10.4	04.7	−00.2		
	1.5		00.1		04.5	08.5	08.5	03.8			
	1.0		00.2		03.8	06.6	06.8	03.1	−00.1		
	0.5		00.1	−00.1	02.6	04.7	05.1	02.1	−00.1		
Center	0.0				00.3	00.2	00.7	−00.4	−00.1		
Aft	−0.5				01.7	03.4	03.4	01.0	−00.2		
	−1.0		−00.1	−00.1	03.1	06.5	06.2	02.5	−00.1		
	−1.5		00.1	−00.1	04.6	08.6	08.4	04.4	−00.1		
	−2.0			−00.1	05.7	10.2	10.2	05.6	−00.1		
	−2.5		00.2	−00.1	05.5	11.4	11.1	05.6	−00.1		
	−3.0				04.4	12.4	11.8	05.2	−00.2		
	−3.5				03.3	13.8	12.8	03.9			
	−4.0				00.5	12.2	12.4	01.0			
	−4.5				−00.2	−10.0	−09.0				
	−5.0					−01.6	−00.1				
	−5.5				−00.2	00.7	00.7				
	−6.0					00.1					
	−6.5										
	−7.0										
	−7.5										
	−8.0										
	−8.5										
	−9.0										

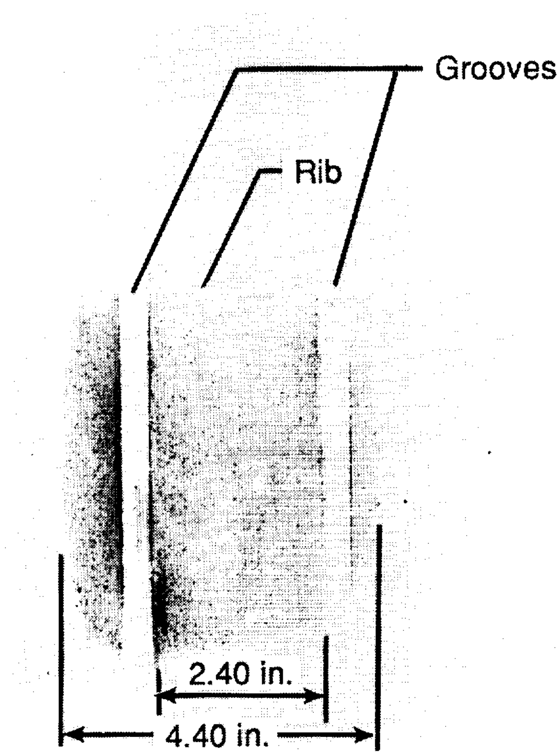
32 × 8.8 Space Shuttle Orbiter Nose Gear Tire Footprint Force Data

[Vertical load = 30 000 lb; tire pressure = 300 psi]

Circumferential position		Drag force, lb, at—									
		Left of centerline, in.					Right of centerline, in.				
Location	in.	−6.12	−4.76	−3.40	−2.04	−0.68	0.68	2.04	3.40	4.76	6.12
	9.0										
	8.5										
	8.0				−00.1	−00.2					
	7.5				−00.1		−00.2	−00.1			
	7.0				−00.1	03.9	02.3	−00.1			
	6.5				01.7	16.3	15.2	01.8			
	6.0				06.5	20.8	20.1	08.8			
	5.5			00.2	10.8	22.0	21.5	15.7			
	5.0			01.8	11.9	21.3	21.2	17.1			
Forward	4.5			04.0	12.9	21.1	20.7	17.2			
	4.0			05.9	13.0	20.6	20.3	17.2	00.8		
	3.5			06.6	13.7	19.6	19.5	16.4	01.3		
	3.0			07.4	11.7	17.2	17.2	13.7	01.9		
	2.5			06.8	11.3	16.2	16.4	11.9	01.9		
	2.0			06.3	11.2	13.9	13.9	10.0	01.7		
	1.5			05.1	08.1	11.0	11.2	07.3	01.5		
	1.0			04.4	07.2	08.4	08.7	04.7	00.7		
	0.5			03.0	04.9	05.6	06.0	01.9			
Center	0.0			01.9	02.5	00.1	00.4	−03.5	−02.5		
	−0.5			02.8	04.2	03.9	03.8	00.1	−01.5		
	−1.0			03.7	07.3	07.9	07.6	02.8	−01.0		
	−1.5			04.6	09.3	10.4	10.5	06.4	00.9		
	−2.0			05.8	11.5	12.7	13.0	09.6	02.0		
	−2.5			06.1	12.7	14.8	14.7	12.1	02.4		
	−3.0			05.7	13.3	16.4	16.5	14.0	02.0		
	−3.5			06.0	14.6	18.7	18.6	16.7	02.0		
	−4.0			00.4	18.0	19.2	19.3	10.3	05.8		
Aft	−4.5			−03.5	−14.2	−20.6	−20.7	−20.6	−00.4		
	−5.0			−01.9	−12.0	−21.1	−20.4	−18.7	−00.2		
	−5.5			−00.2	−13.5	−22.8	−21.9	−19.2	−00.1		
	−6.0				−08.8	−21.7	−20.9	−11.5			
	−6.5				−02.8	−17.2	−16.1	−02.5			
	−7.0					−04.7	−04.0				
	−7.5					00.2	00.1				
	−8.0					00.1	00.1				
	−8.5										
	−9.0										

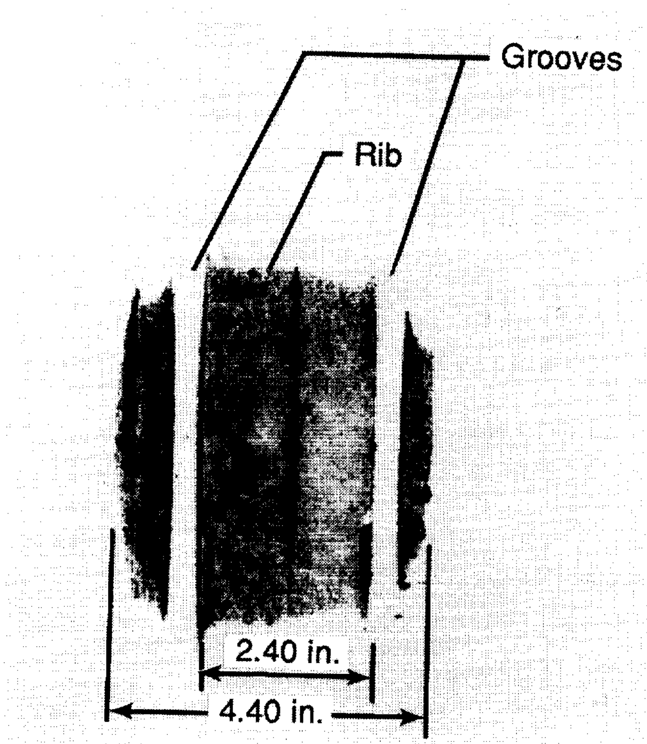
40 × 14 Commercial Airplane Tire Footprint

[Vertical load = 2000 lb; tire pressure = 140 psi]



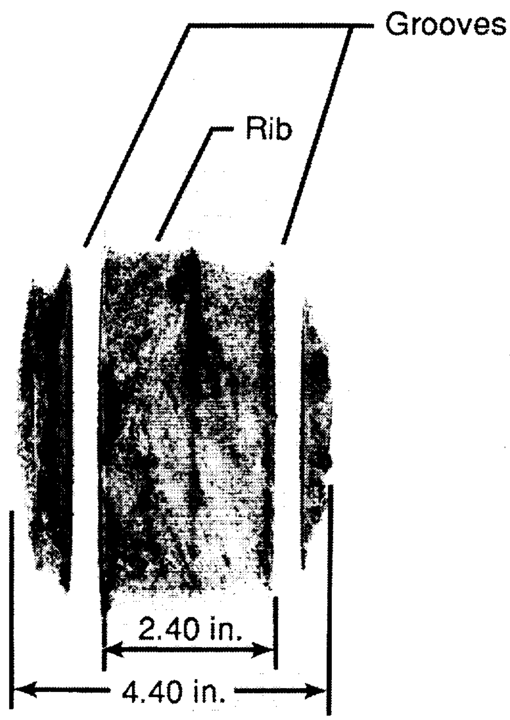
40 × 14 Commercial Airplane Tire Footprint

[Vertical load = 2000 lb; tire pressure = 155 psi]



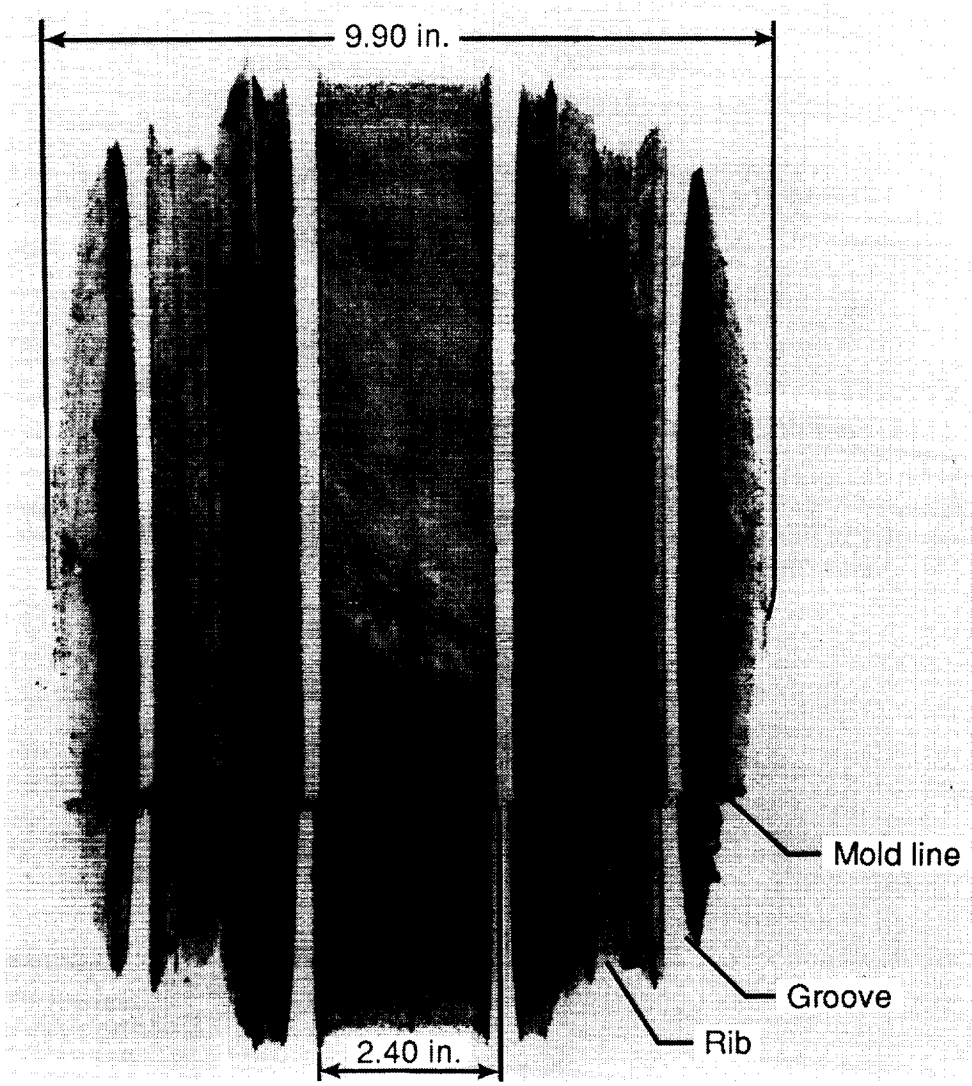
40 × 14 Commercial Airplane Tire Footprint

[Vertical load = 2000 lb; tire pressure = 170 psi]



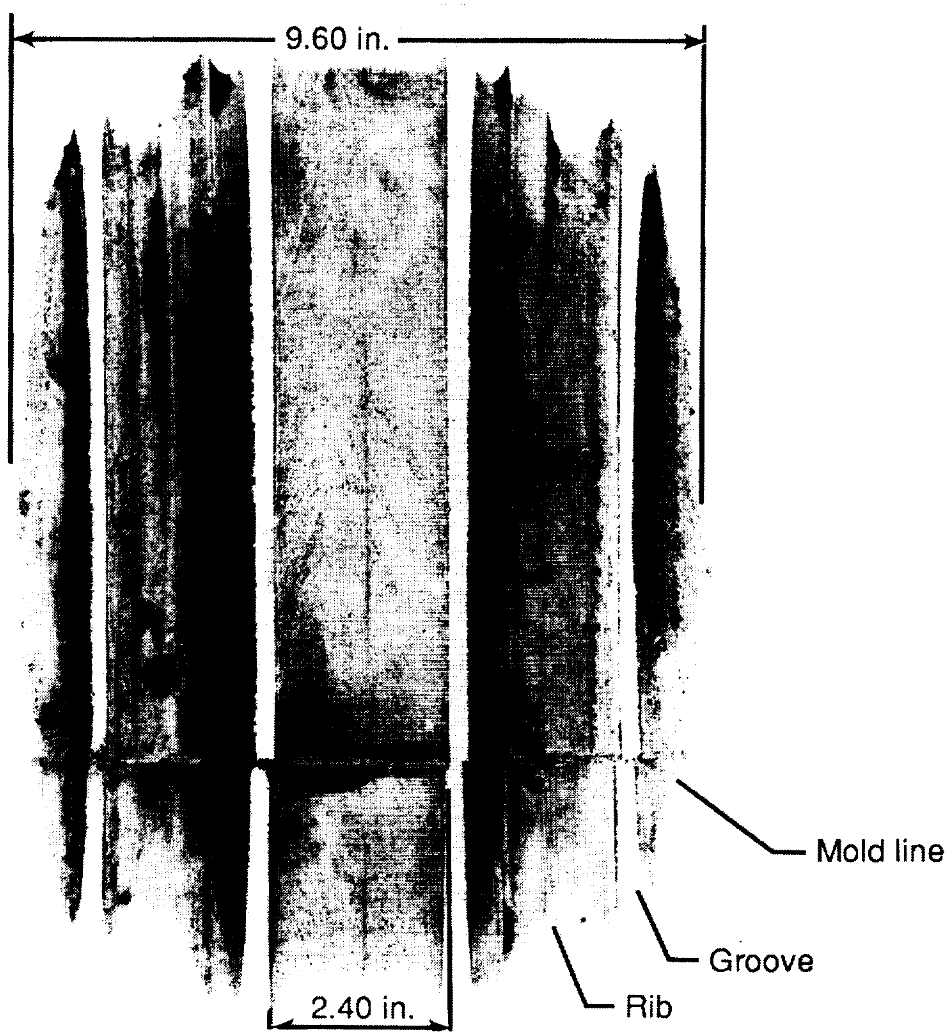
40 × 14 Commercial Airplane Tire Footprint

[Vertical load = 16 000 lb; tire pressure = 140 psi]



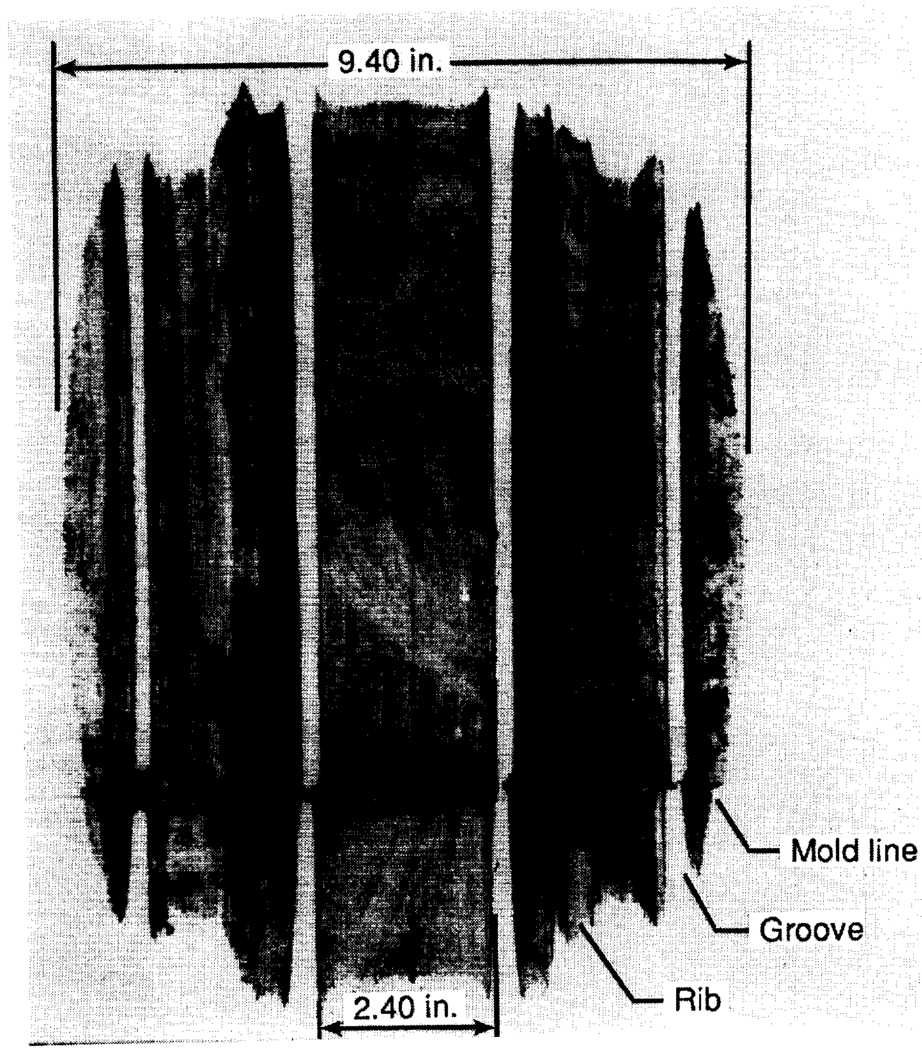
40 × 14 Commercial Airplane Tire Footprint

[Vertical load = 16 000 lb; tire pressure = 155 psi]



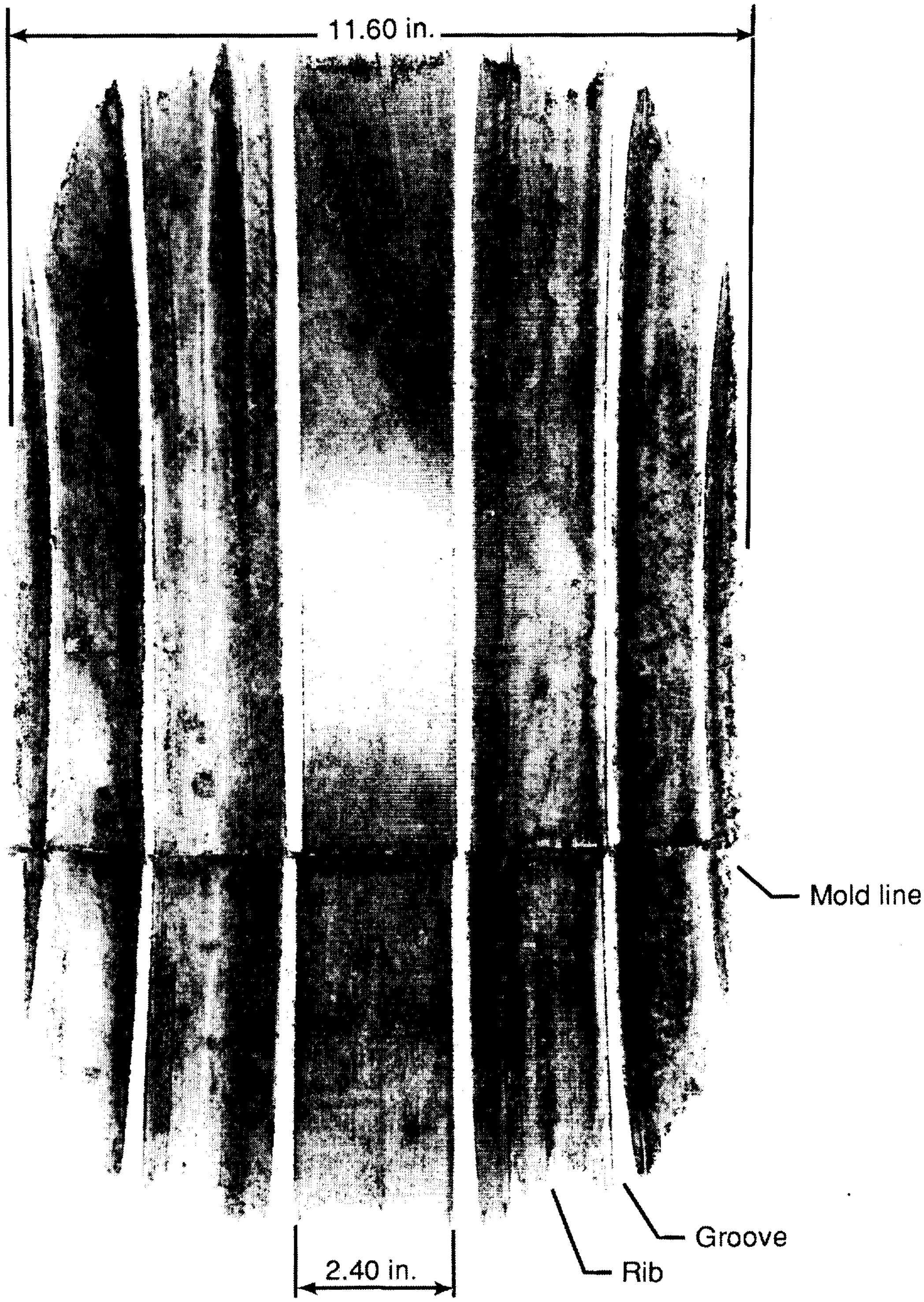
40 × 14 Commercial Airplane Tire Footprint

[Vertical load = 16 000 lb; tire pressure = 170 psi]



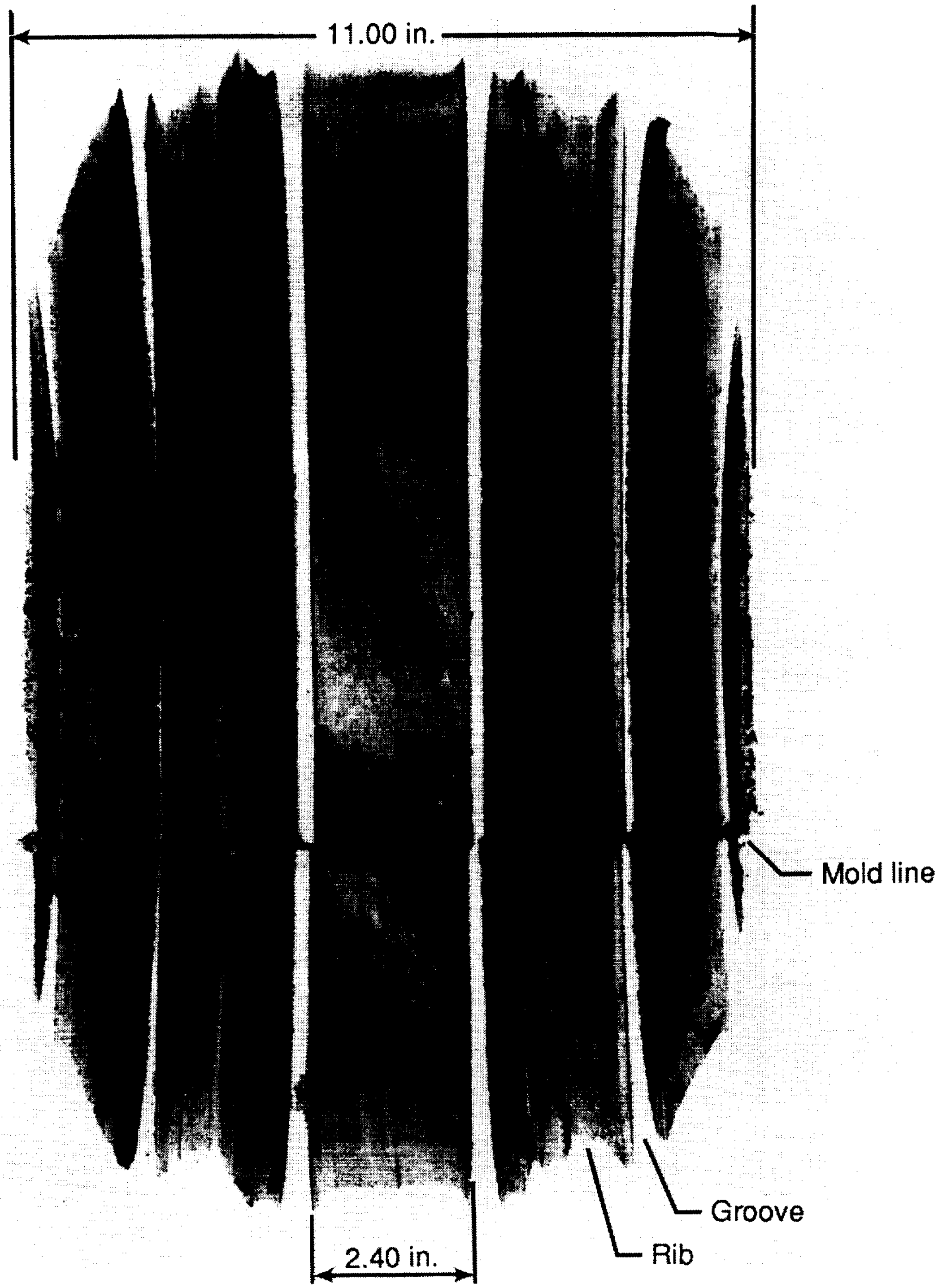
40 × 14 Commercial Airplane Tire Footprint

[Vertical load = 30 000 lb; tire pressure = 140 psi]



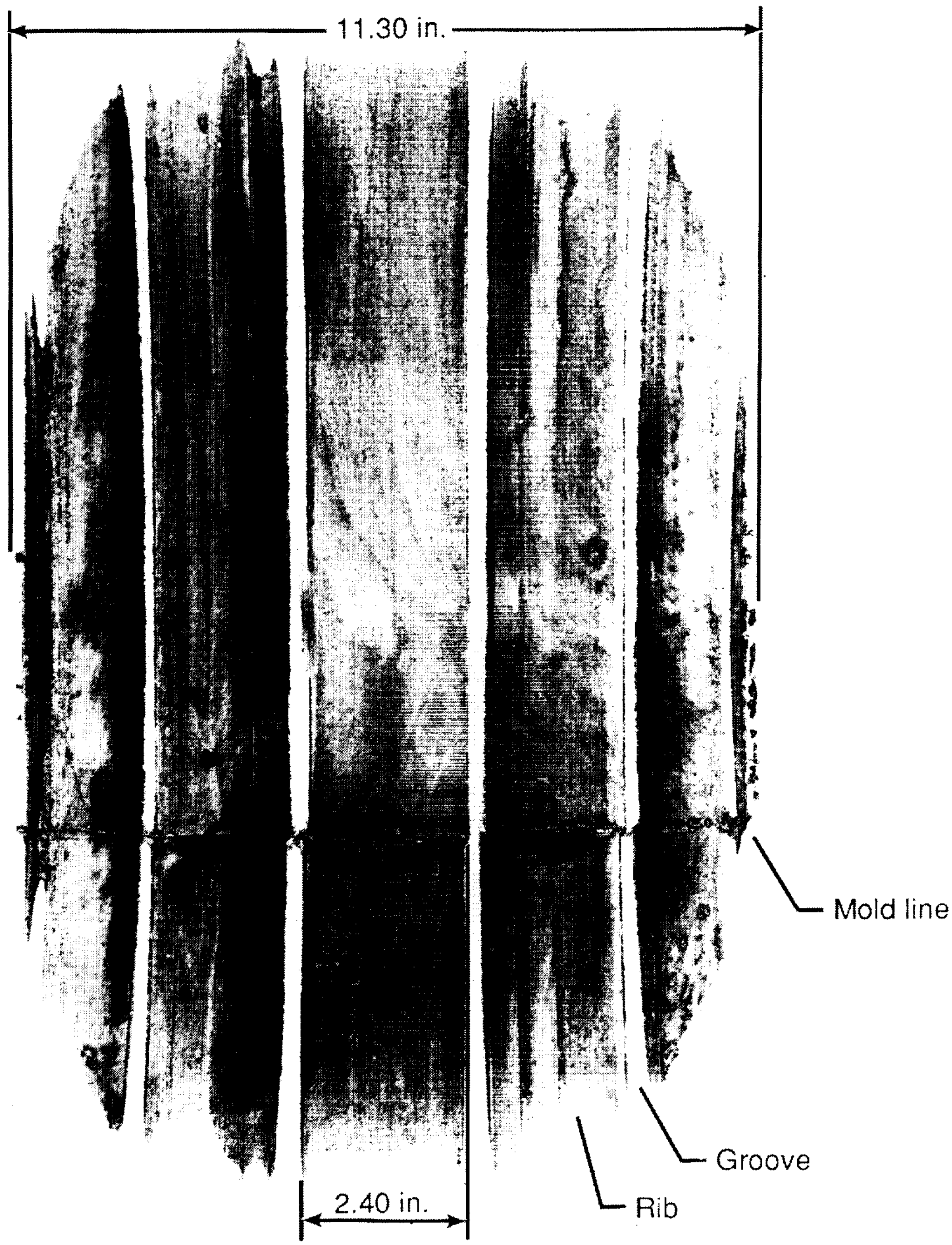
40 × 14 Commercial Airplane Tire Footprint

[Vertical load = 30 000 lb; tire pressure = 155 psi]



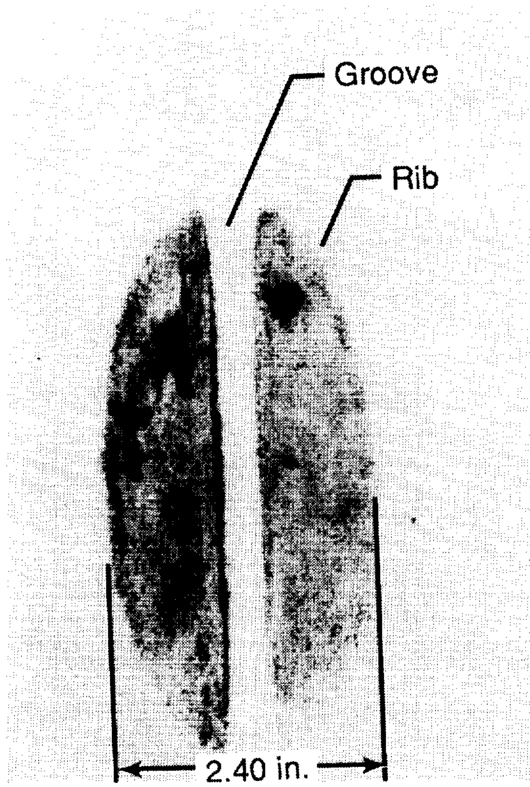
40 × 14 Commercial Airplane Tire Footprint

[Vertical load = 30 000 lb; tire pressure = 170 psi]



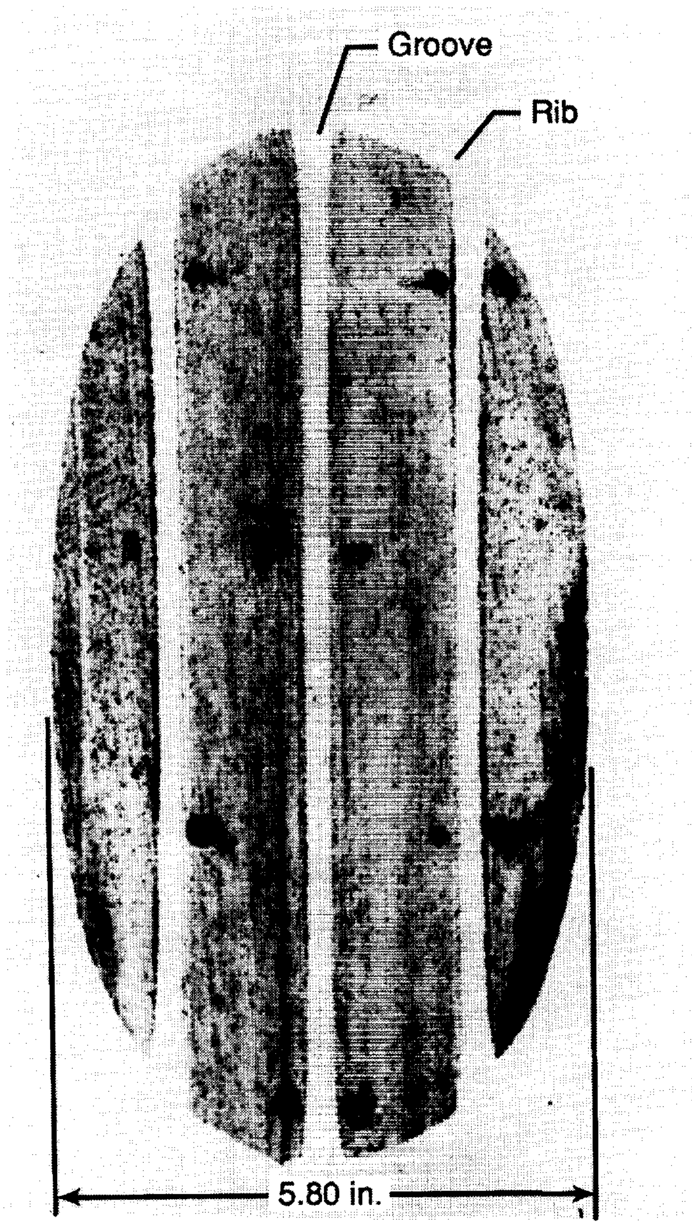
32 × 8.8 Space Shuttle Orbiter Nose Gear Tire Footprint

[Vertical load = 2000 lb; tire pressure = 300 psi]



32 × 8.8 Space Shuttle Orbiter Nose Gear Tire Footprint

[Vertical load = 15 000 lb; tire pressure = 300 psi]

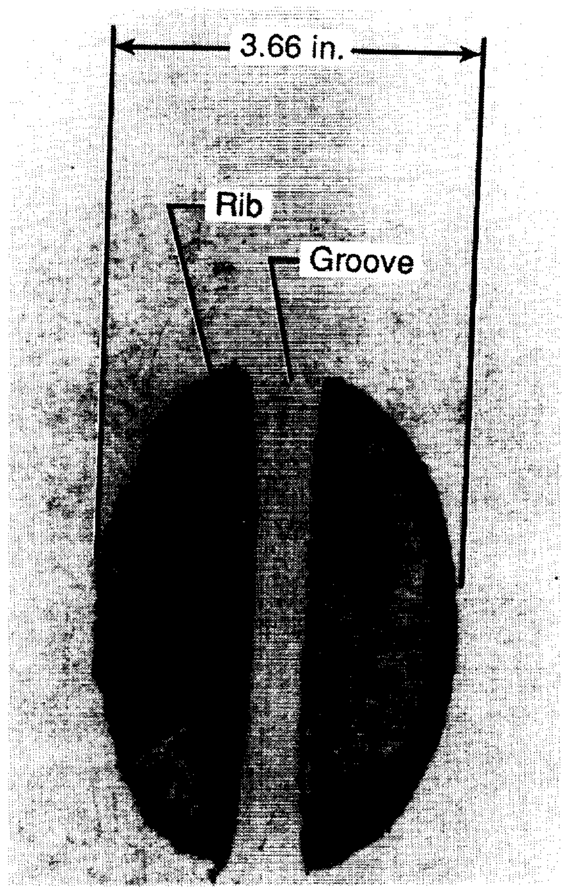


32 × 8.8 Space Shuttle Orbiter Nose Gear Tire Footprint

[Vertical load = 30 000 lb; tire pressure = 300 psi]

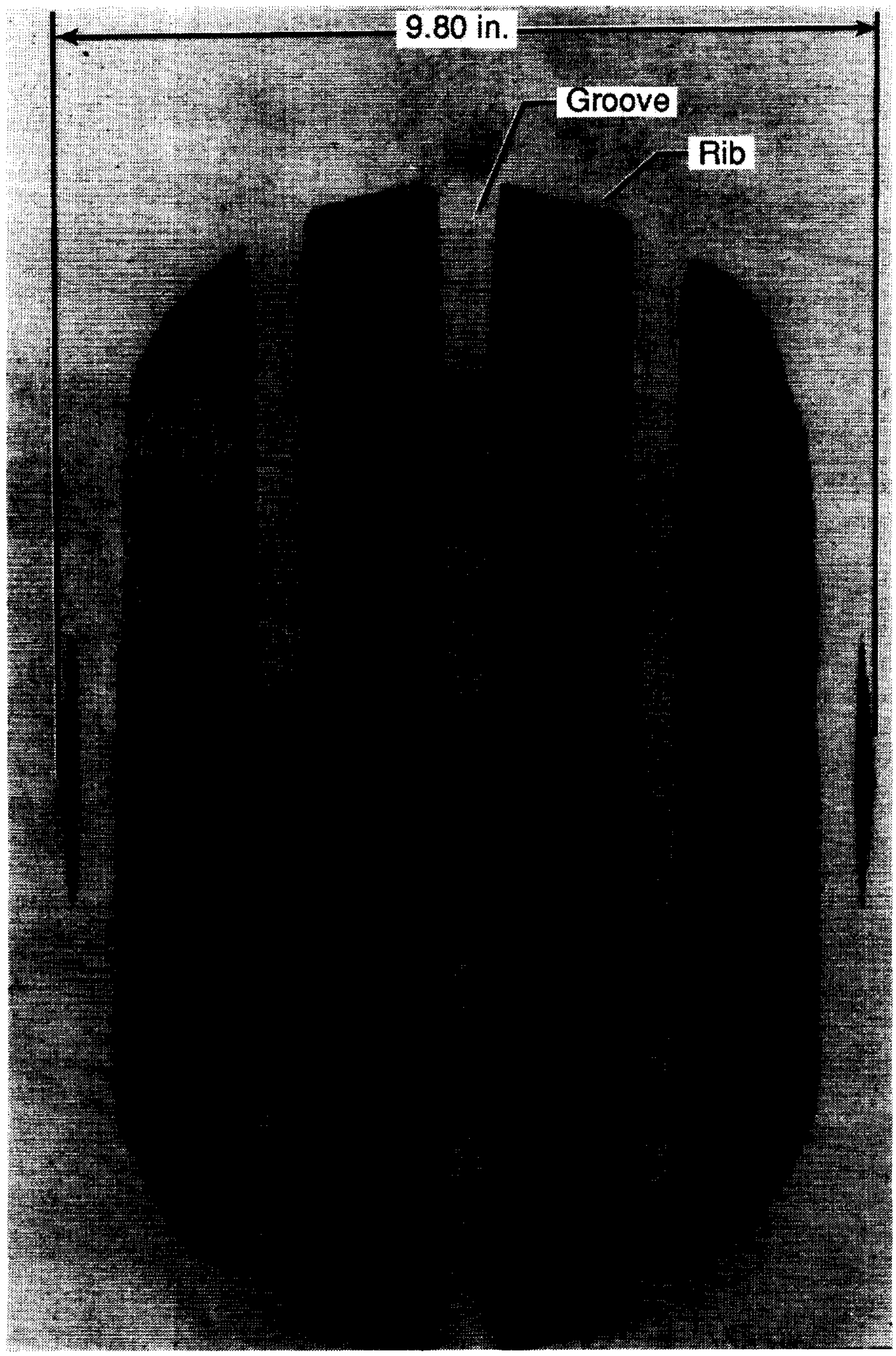
44.5 × 16 Space Shuttle Orbiter Main Gear Tire Footprint

[Vertical load = 2000 lb; tire pressure = 315 psi]



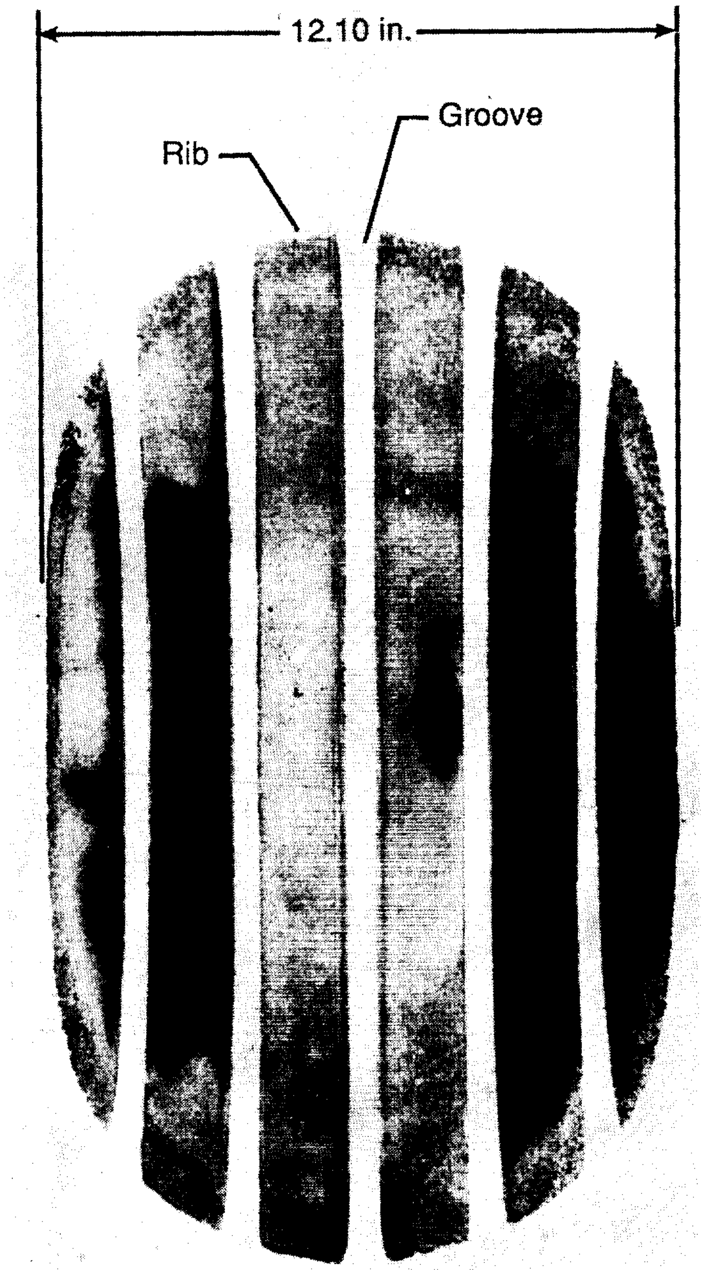
44.5 × 16 Space Shuttle Orbiter Main Gear Tire Footprint

[Vertical load = 30 000 lb; tire pressure = 315 psi]



44.5 × 16 Space Shuttle Orbiter Main Gear Tire Footprint

[Vertical load = 60 000 lb; tire pressure = 315 psi]



44.5 $\times$ 16 Space Shuttle Orbiter Main Gear Tire Footprint

[Vertical load = 66 000 lb; tire pressure = 315 psi]

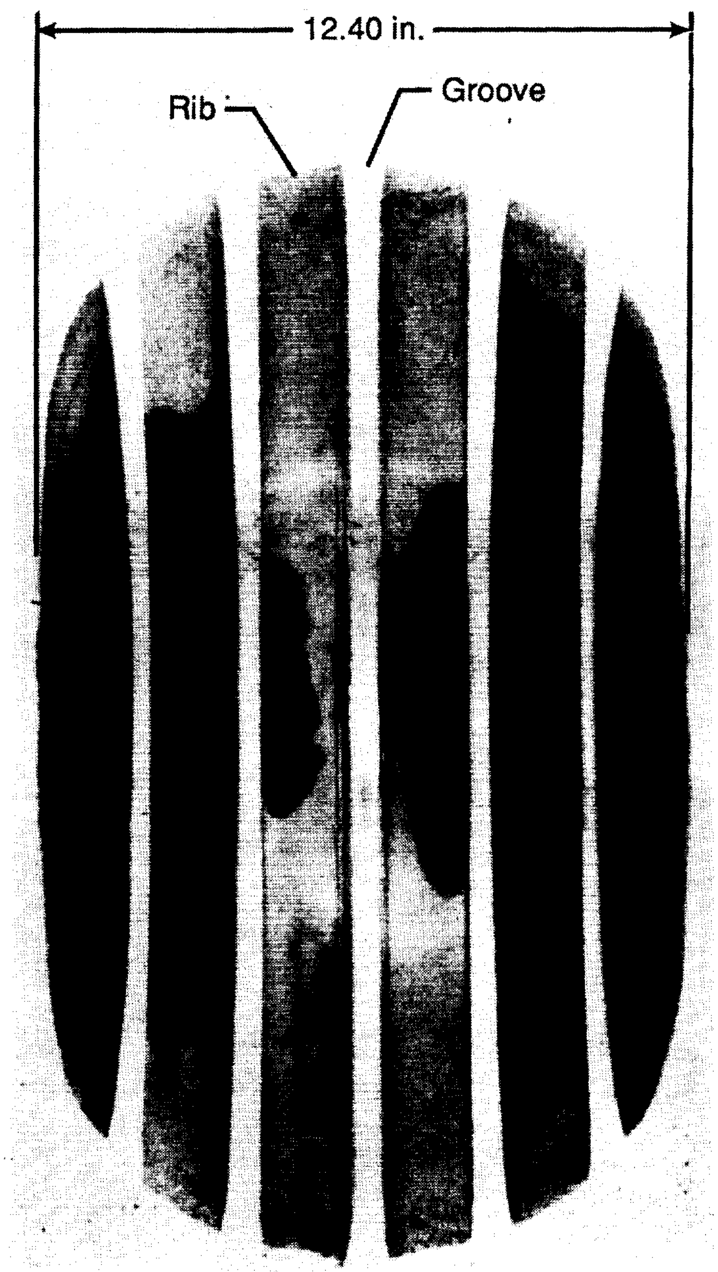


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Table I. Tire Test Matrix

Tire	Inflation pressure, psi	Footprint forces, lb	Footprint areas, in^2	Footprint aspect ratios (Width/Length)
40 × 14	140	X	X	X
	155	X	X	X
	170	X	X	X
32 × 8.8	300	X	X	X
44.5 × 16	315		X	X

Table II. Footprint Areas and Aspect Ratios for 40 × 14 Commercial Aircraft Tire

Vertical load, lb	Footprint gross area, in^2	Footprint net area, in^2	$\frac{\text{Net area}}{\text{Gross area}}$	Footprint length, L, in.	Footprint width, W, in.	Footprint aspect ratio, W/L
140 psi						
10 000	67.54	55.85	0.83	9.50	8.38	0.88
12 120	91.13	76.74	.84	11.40	8.96	.79
14 120	102.08	89.24	.87	12.20	9.40	.77
16 120	114.94	100.79	.88	13.10	9.90	.76
18 000	125.04	109.74	.88	13.80	10.00	.72
20 040	136.70	120.42	.88	14.60	10.40	.71
22 000	147.89	130.12	.88	15.40	10.70	.69
24 080	159.92	140.41	.88	16.10	10.80	.67
26 120	172.00	151.48	.88	16.90	11.00	.65
28 120	182.26	162.24	.89	17.60	11.20	.64
30 120	192.35	170.21	.89	18.00	11.60	.64
155 psi						
10 040	73.96	61.67	0.83	10.00	8.56	0.86
12 040	85.46	72.58	.85	10.90	8.80	.81
14 080	95.68	82.24	.86	11.70	9.20	.77
16 080	107.52	93.45	.87	12.60	9.60	.76
18 080	116.81	102.05	.87	13.20	10.05	.76
20 000	128.11	113.22	.88	13.95	10.35	.74
22 040	138.71	122.57	.88	14.60	10.50	.72
24 000	149.47	134.03	.90	15.40	10.70	.69
26 080	159.79	142.01	.89	16.00	10.80	.68
28 040	169.69	150.18	.89	16.60	10.90	.66
30 040	177.77	160.91	.91	17.30	11.00	.64
170 psi						
10 040	72.84	62.35	0.86	9.90	8.50	0.86
12 080	81.68	70.48	.86	10.60	8.75	.83
14 040	92.22	80.60	.87	11.40	9.08	.80
16 040	102.42	88.98	.87	12.15	9.40	.77
18 040	111.98	97.91	.87	12.86	9.70	.75
20 000	122.65	108.12	.88	13.50	10.20	.76
22 040	133.24	117.59	.88	14.24	10.46	.73
24 080	143.18	124.48	.87	14.82	10.76	.73
26 040	152.46	132.80	.87	15.40	10.80	.70
28 040	161.59	141.47	.88	16.00	10.90	.68
30 080	169.84	149.90	.88	16.60	11.30	.68

Table III. Footprint Areas and Aspect Ratios for 32 × 8.8 Space Shuttle Orbiter Nose Gear Tire Inflated to 300 psi

Vertical load, lb	Footprint gross area, in^2	Footprint net area, in^2	$\dfrac{\text{Net area}}{\text{Gross area}}$	Footprint length, L, in.	Footprint width, W, in.	Footprint aspect ratio, W/L
6 143	23.37	18.62	0.80	7.50	3.92	0.52
6 168	23.20	18.38	.79	7.60	3.86	.51
6 327	23.67	18.79	.79	7.64	3.88	.51
7 130	26.78	21.43	.80	8.10	4.16	.51
7 254	27.68	21.91	.79	8.10	4.30	.53
7 587	28.62	22.43	.78	8.34	4.36	.52
8 031	30.34	24.22	.80	8.50	4.54	.53
8 115	30.21	23.83	.79	8.55	4.46	.52
8 421	30.83	24.43	.79	8.64	4.50	.52
9 021	33.00	26.20	.79	8.92	4.62	.52
9 192	34.15	27.60	.81	8.90	4.74	.53
9 458	34.37	27.94	.81	9.10	4.74	.52
10 011	36.00	29.06	.81	9.30	4.84	.52
10 138	37.33	30.57	.82	9.32	4.94	.53
10 142	31.91	29.02	.79	9.40	4.92	.52
12 141	43.66	35.42	.81	10.10	5.30	.53
12 198	43.76	35.93	.82	10.08	5.36	.53
12 541	43.97	36.46	.83	10.20	5.33	.52
14 097	48.82	40.47	.83	10.70	5.58	.52
14 137	49.57	41.34	.83	10.70	5.66	.53
14 145	49.22	41.07	.83	10.75	5.60	.52
15 129	51.56	43.38	.84	11.05	5.80	.52
15 132	52.53	43.50	.83	11.10	5.78	.52
15 159	51.56	43.38	.84	11.08	5.82	.53
16 048	54.78	45.12	.82	11.36	5.90	.52
16 236	56.46	46.78	.83	11.42	6.00	.53
16 397	55.75	47.23	.85	11.40	5.90	.52
18 186	61.78	52.07	.84	11.96	6.24	.52
18 190	60.40	51.36	.85	11.34	5.88	.52
18 390	61.76	51.42	.83	12.00	6.20	.52
19 020	64.40	54.91	.85	12.20	6.35	.52
19 154	68.50	59.26	.87	12.28	6.30	.51
19 343	62.68	52.58	.84	12.35	6.35	.51
20 015	67.62	57.34	.85	12.46	6.52	.52
20 079	67.61	57.10	.84	12.55	6.46	.52
20 463	71.36	61.05	.86	12.46	6.42	.52
21 087	74.53	63.87	.86	12.70	6.50	.51
21 156	70.78	60.24	.85	12.75	6.62	.52
21 176	69.42	58.38	.84	12.75	6.56	.52
22 075	72.63	61.40	.85	12.98	6.70	.52
22 094	73.65	63.93	.87	13.04	6.78	.52
22 308	76.42	65.32	.85	12.96	6.68	.52
22 732	74.26	61.99	.83	13.20	6.80	.52
24 048	79.49	67.78	.85	13.50	6.96	.52
24 140	80.44	70.72	.88	13.60	7.06	.52
24 203	81.61	70.23	.86	13.36	6.86	.51

Table III. Concluded

Vertical load, lb	Footprint gross area, in^2	Footprint net area, in^2	$\frac{\text{Net area}}{\text{Gross area}}$	Footprint length, L, in.	Footprint width, W, in.	Footprint aspect ratio, W/L
26 040	85.64	74.73	0.87	14.00	7.26	0.52
26 049	88.65	76.61	.86	13.90	7.16	.52
26 097	86.98	75.24	.87	13.86	7.10	.51
28 014	92.76	80.89	.87	14.36	7.34	.51
28 048	92.08	81.28	.88	14.45	7.54	.52
28 320	95.52	82.97	.87	14.50	7.40	.51
29 019	95.10	83.11	.87	14.56	7.44	.51
29 037	94.06	83.20	.88	14.68	7.58	.52
29 132	95.94	82.49	.86	14.65	7.50	.51
30 084	97.09	85.89	.88	14.90	7.72	.52
30 102	98.40	86.14	.88	14.86	7.60	.51
30 178	96.05	83.42	.87	14.80	7.66	.52

Table IV. Footprint Areas and Aspect Ratios for 44.5 × 16 Space Shuttle Orbiter Main Gear Tire Inflated to 315 psi

Vertical load, lb	Footprint gross area, in^2	Footprint net area, in^2	$\frac{\text{Net area}}{\text{Gross area}}$	Footprint length, L, in.	Footprint width, W, in.	Footprint aspect ratio, W/L
10 100	44.20	31.60	0.71	8.74	6.44	0.74
23 000	86.68	67.76	.78	12.40	8.20	.66
29 998	110.57	82.85	.75	13.95	9.80	.70
40 000	147.53	108.51	.74	16.20	10.98	.68
40 000	147.99	113.71	.77	16.26	10.94	.67
52 000	182.20	140.39	.77	18.20	11.70	.64
51 000	201.15	157.05	.78	19.75	12.10	.61
66 000	227.29	178.37	.78	20.60	12.40	.60

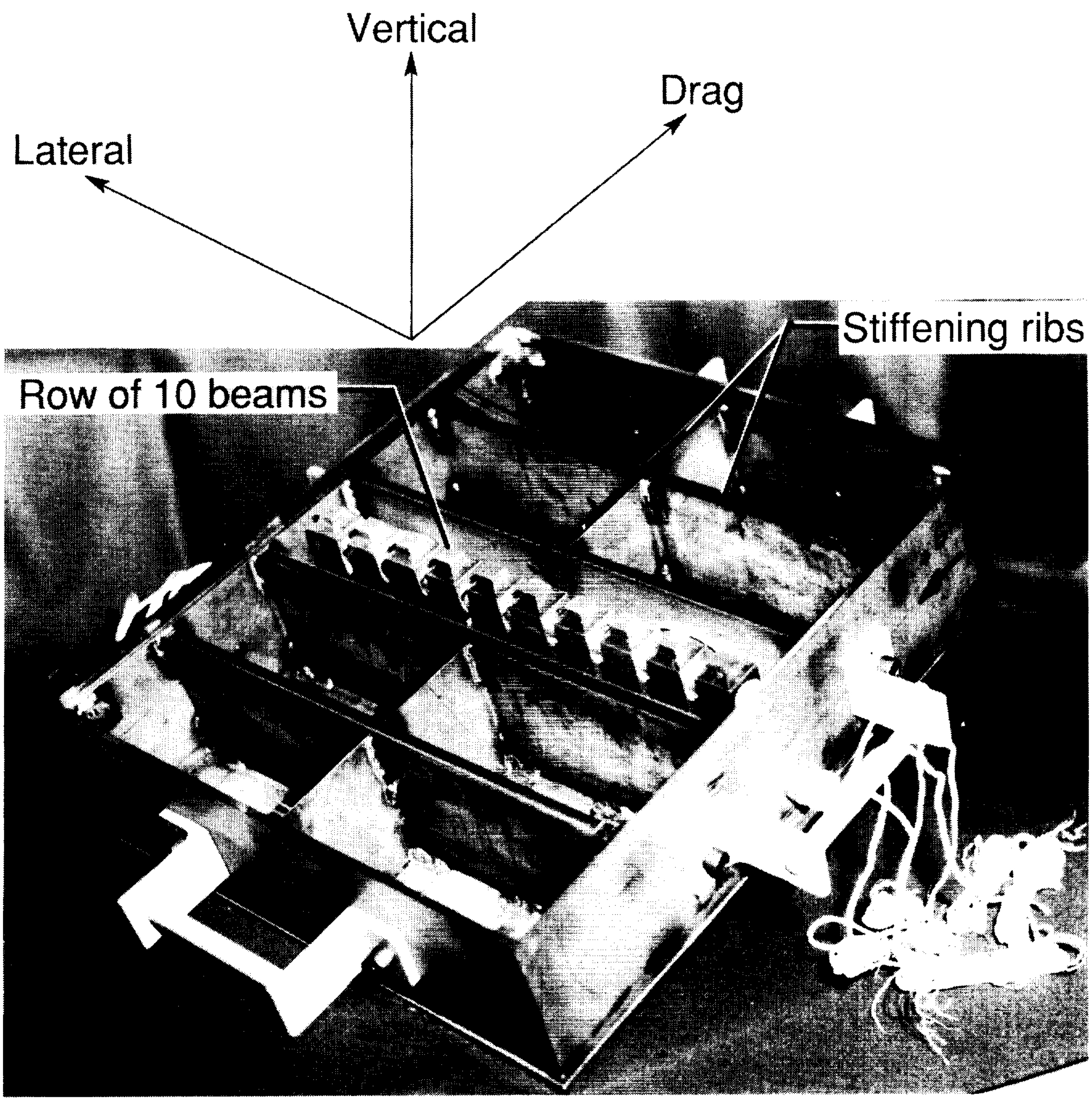

Figure 1. Interior view of the footprint force transducer showing the 10 strain-gaged beams.

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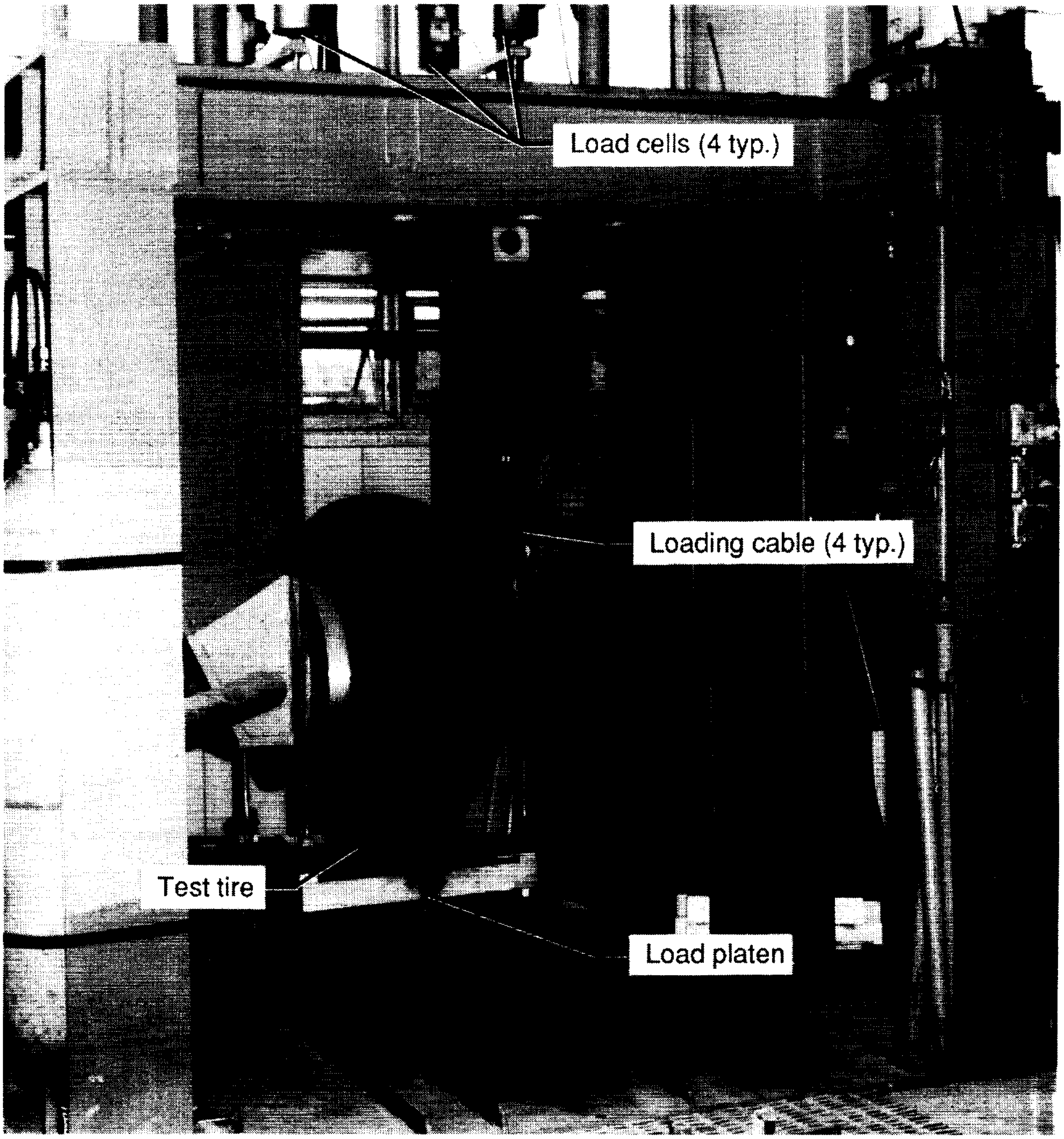

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Figure 2. Dynamic test fixture with 40 × 14 aircraft tire mounted for testing.

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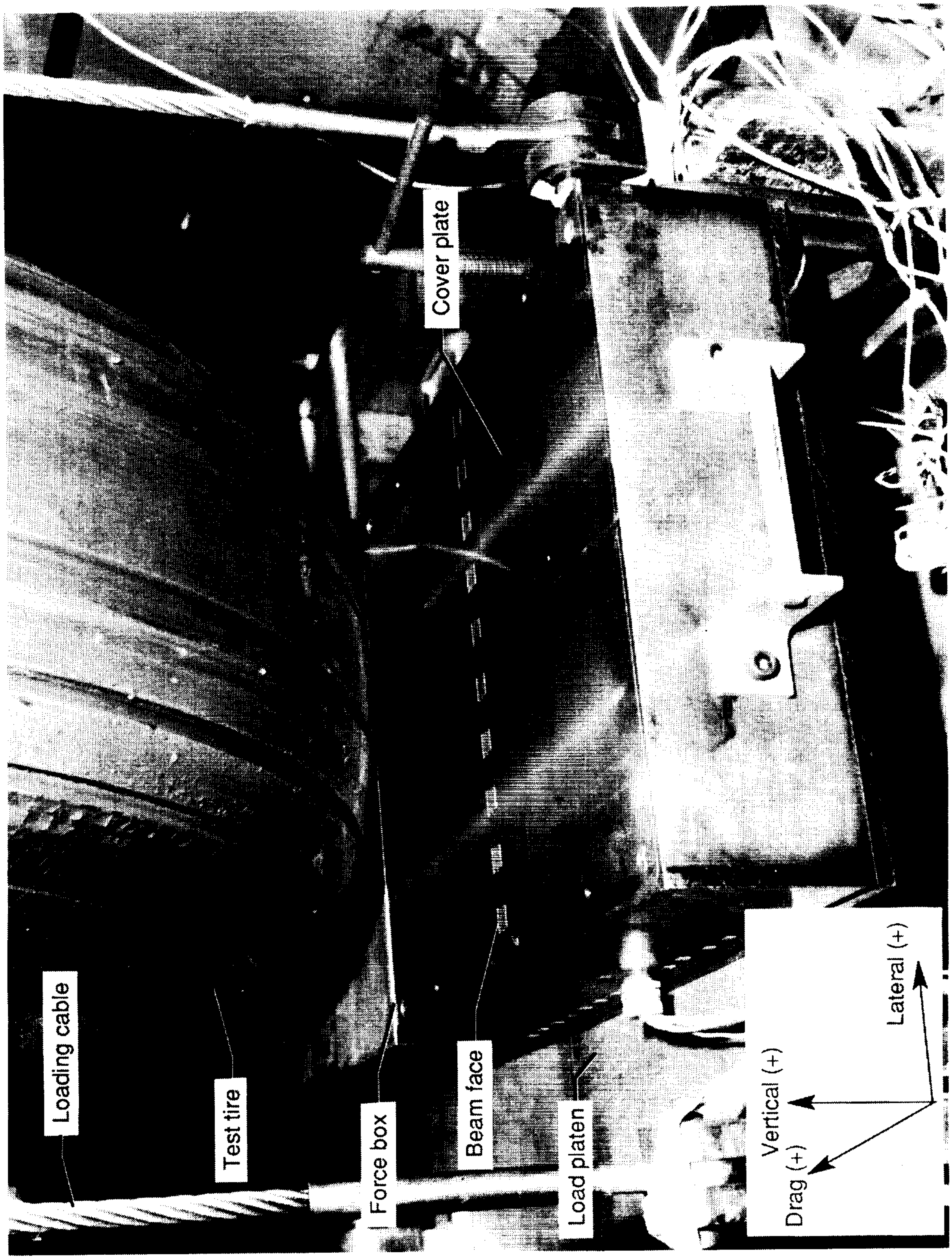

Figure 3. Test arrangement of 40 × 14 aircraft tire and footprint force transducer.

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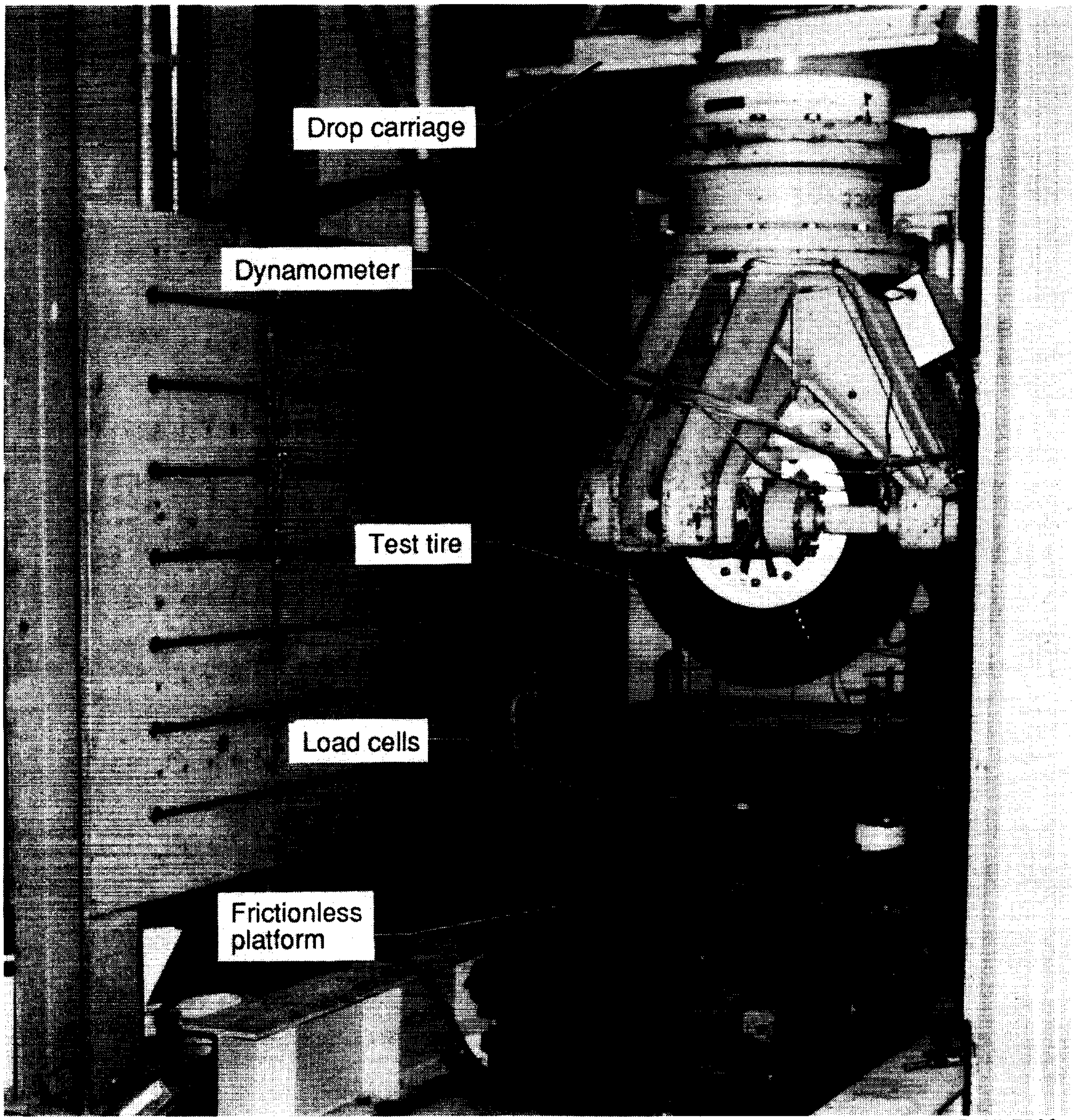
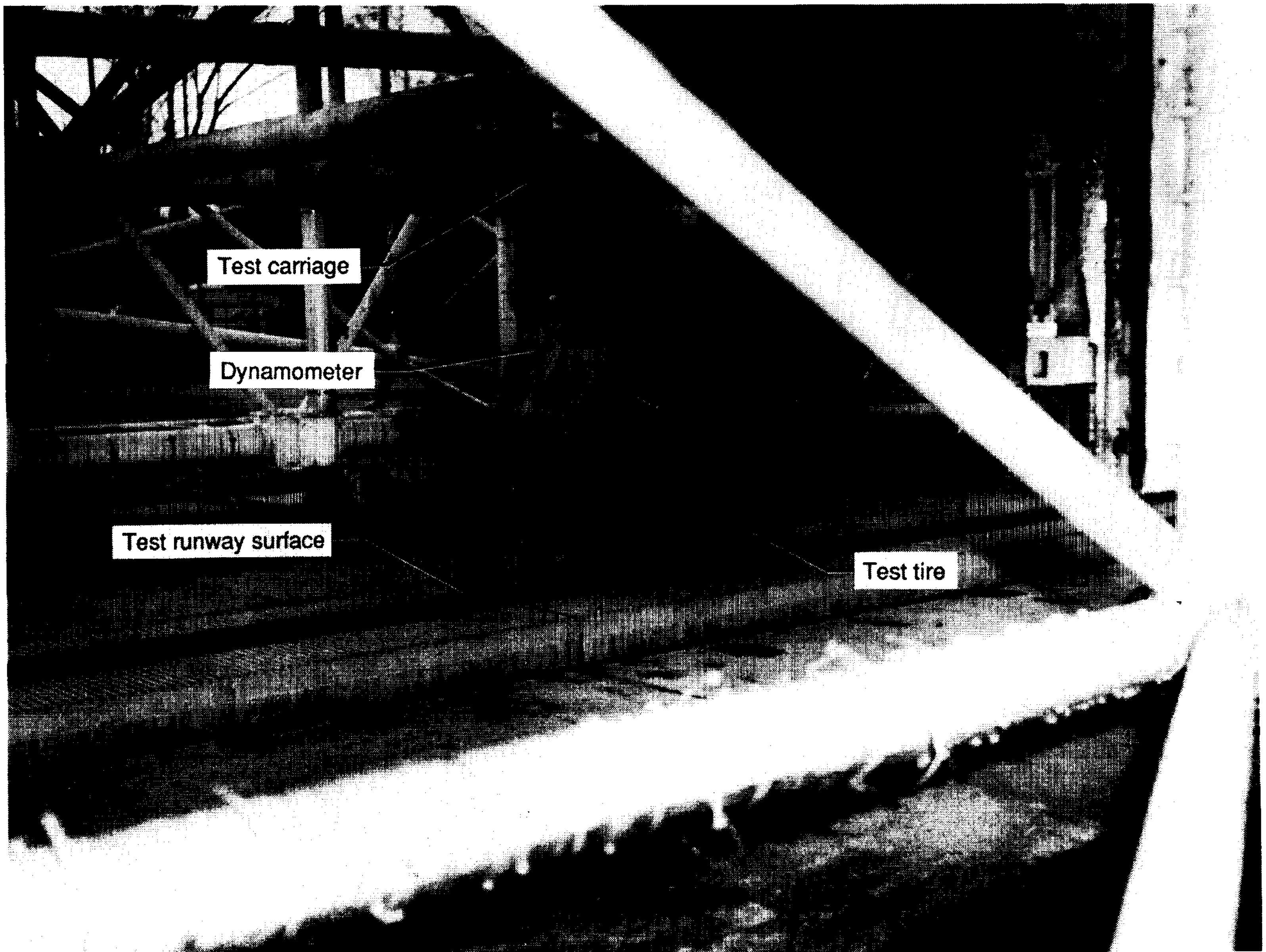


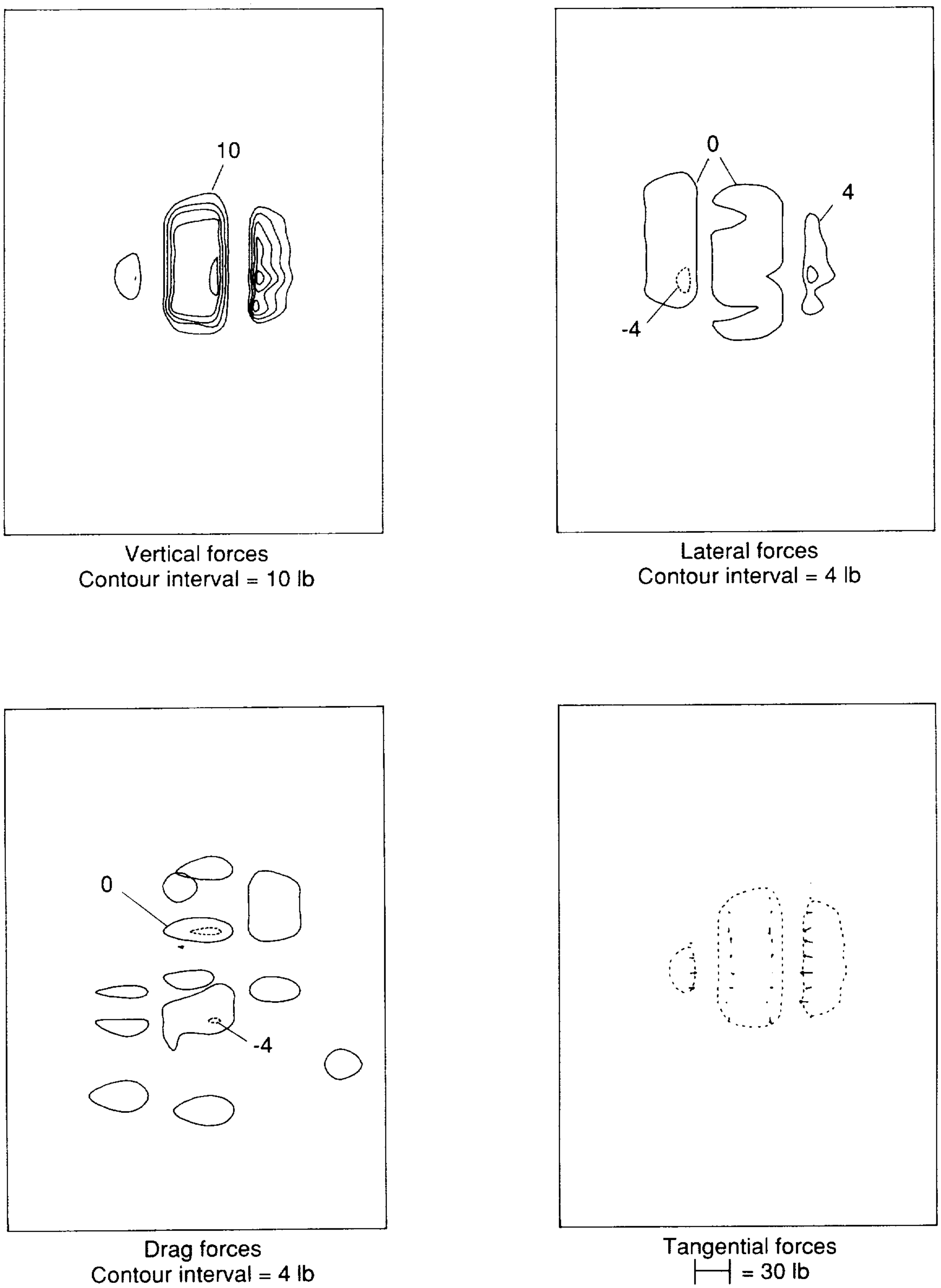
L-85-7586

Figure 4. Static test fixture with Space Shuttle orbiter nose gear tire mounted for testing.



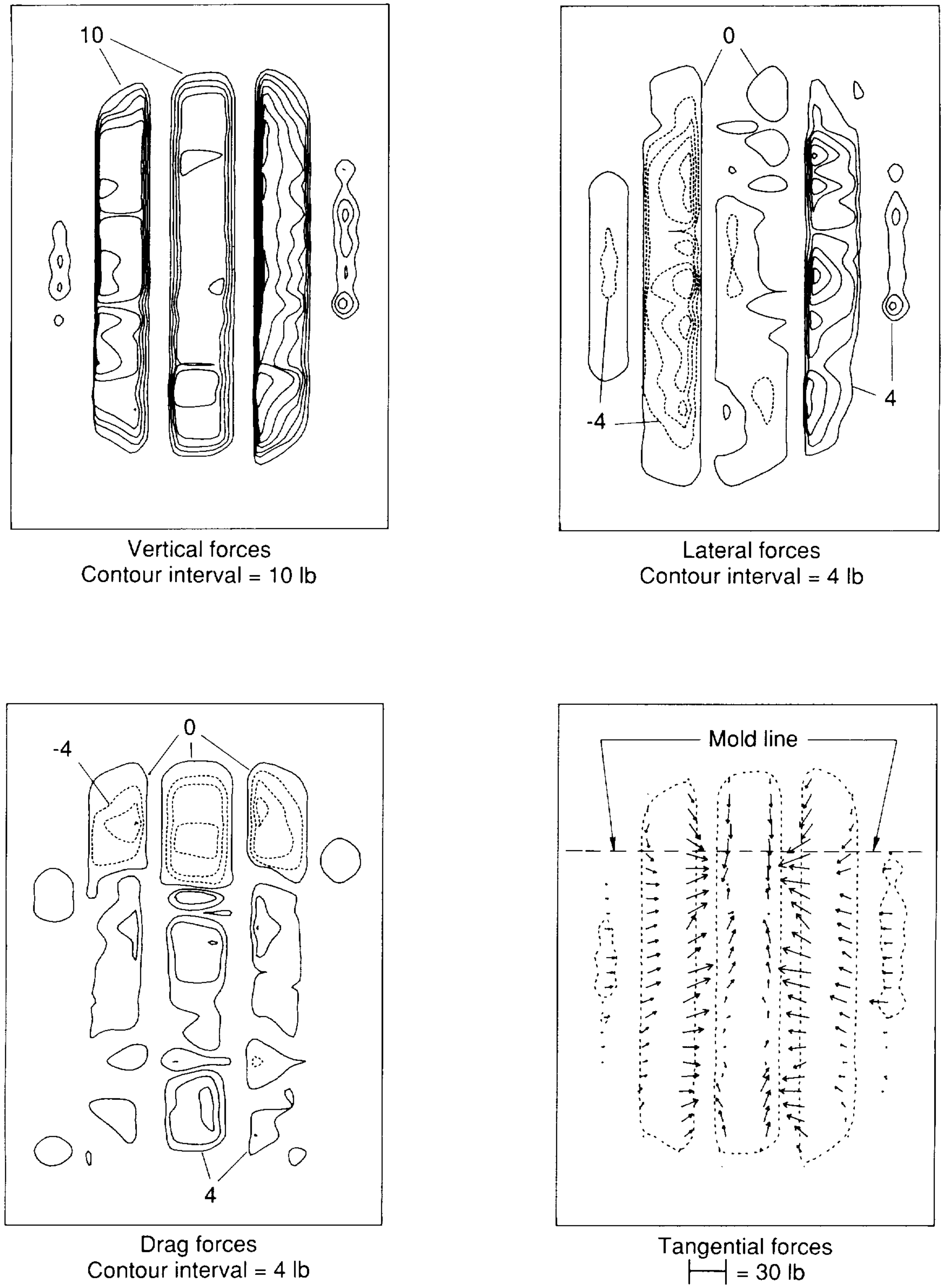
L-86-10770

Figure 5. Test carriage with Space Shuttle orbiter main gear tire mounted for testing.



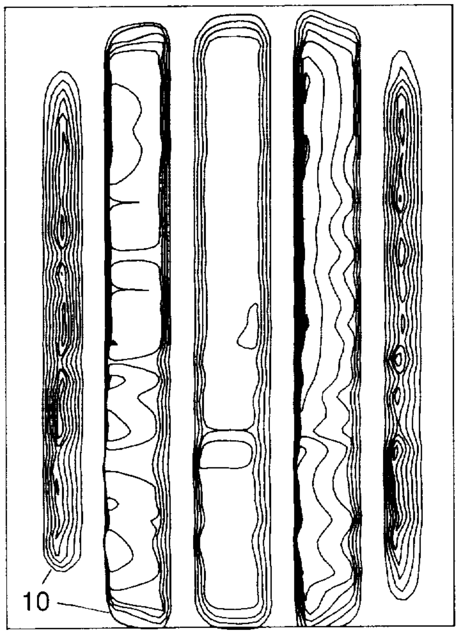
(a) Vertical load of 2000 lb.

Figure 6. Footprint local force contours for 40 × 14 aircraft tire inflated to 140 psi.

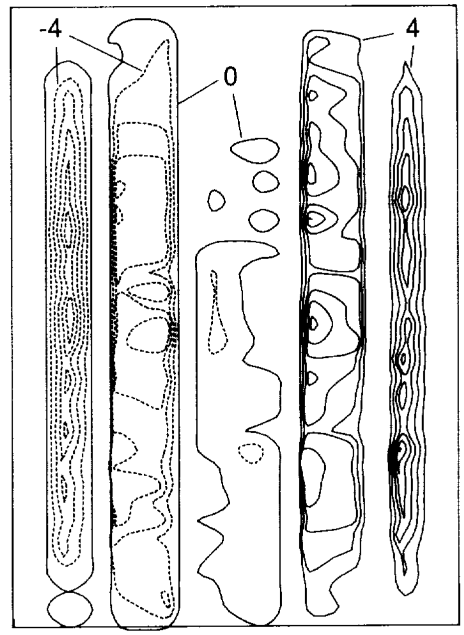


(b) Vertical load of 16 000 lb.

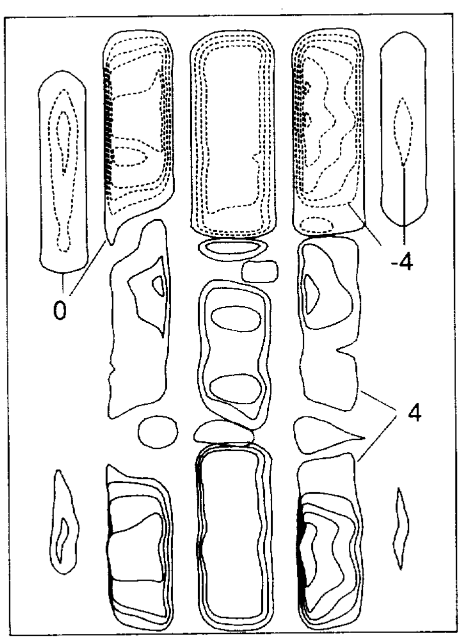
Figure 6. Continued.



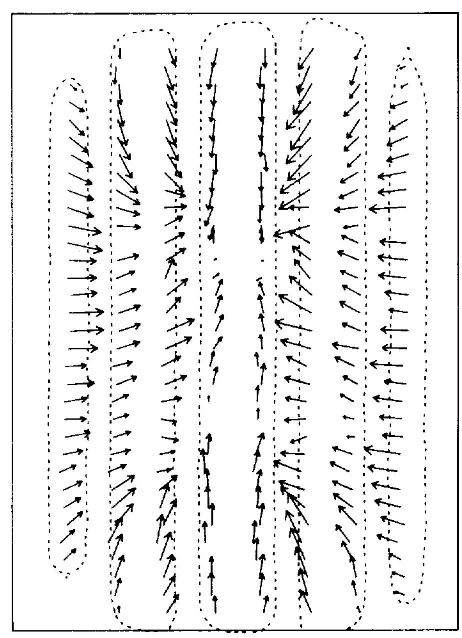
Vertical forces
Contour interval = 10 lb



Lateral forces
Contour interval = 4 lb



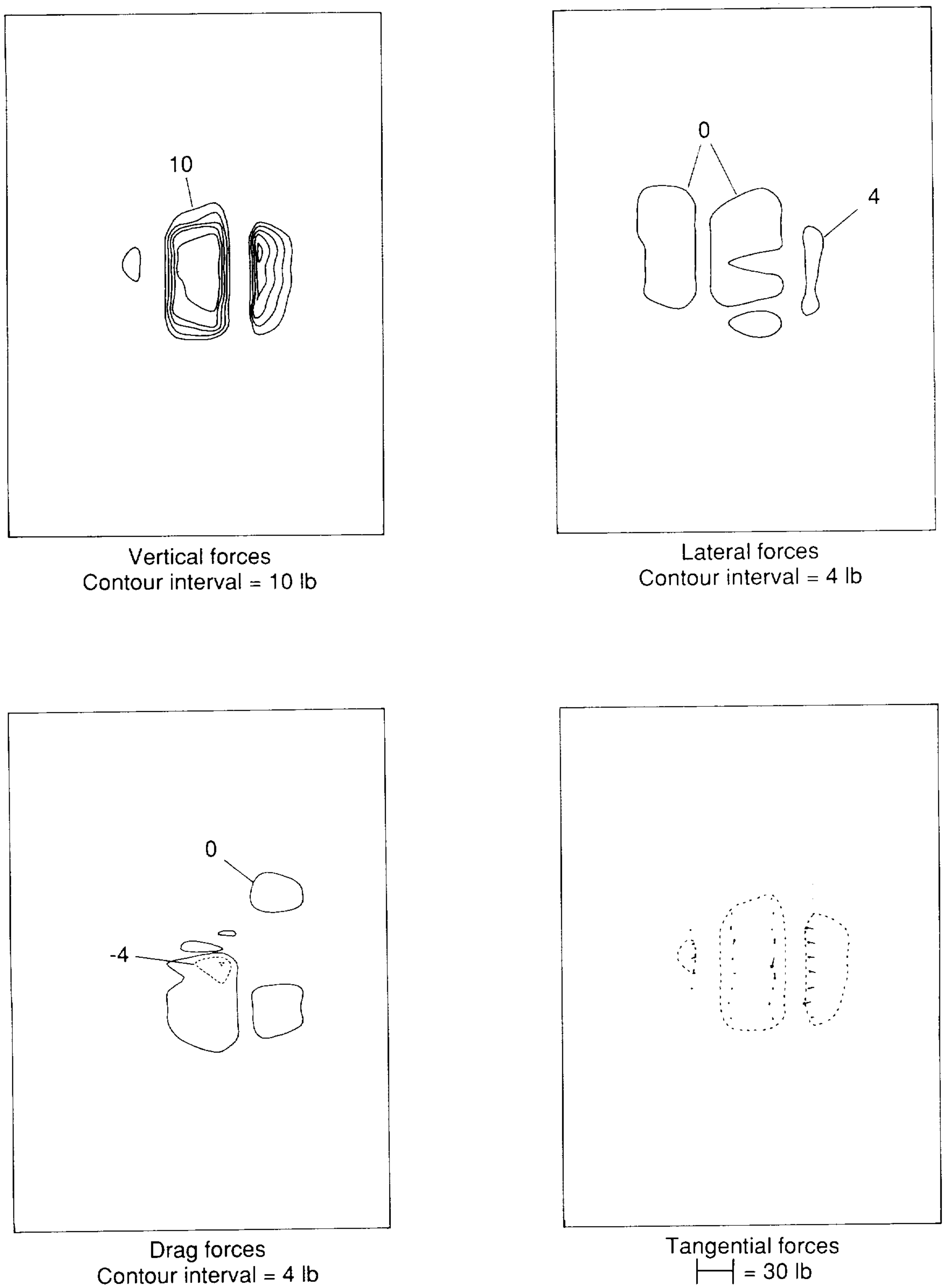
Drag forces
Contour interval = 4 lb



Tangential forces
= 30 lb

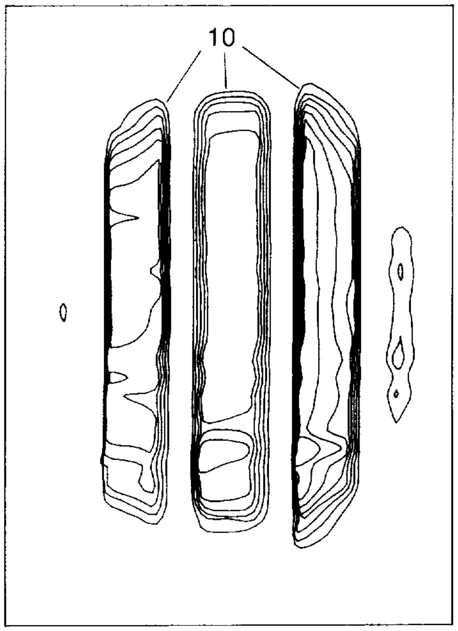
(c) Vertical load of 30 000 lb.

Figure 6. Concluded.

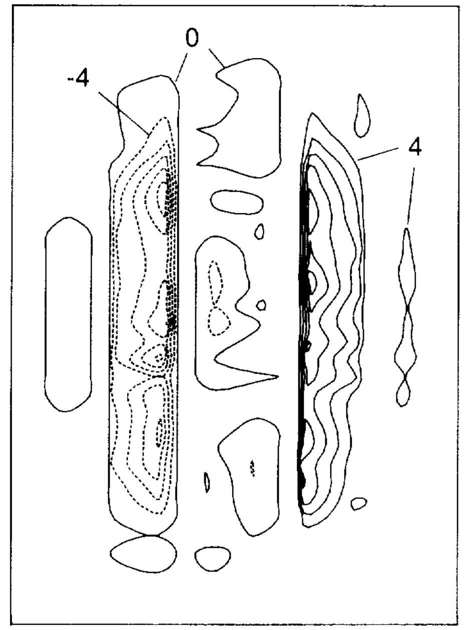


(a) Vertical load of 2000 lb.

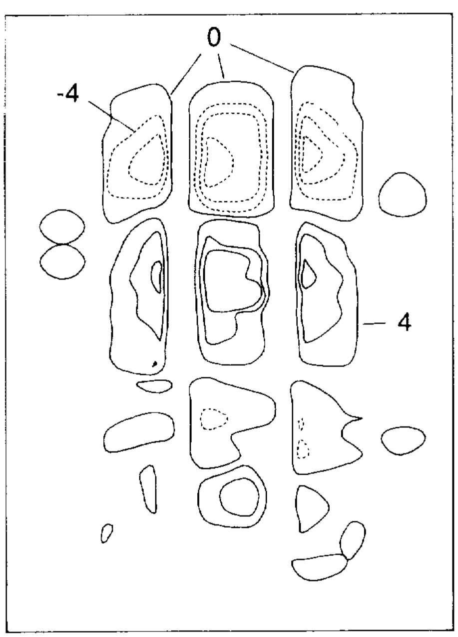
Figure 7. Footprint local force contours for 40 × 14 aircraft tire inflated to 155 psi.



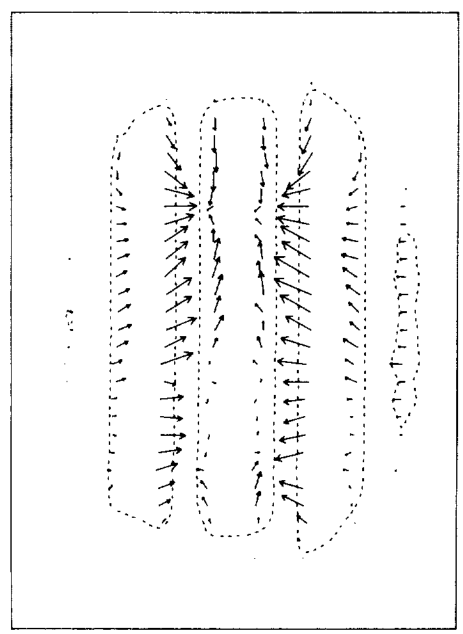
Vertical forces
Contour interval = 10 lb



Lateral forces
Contour interval = 4 lb



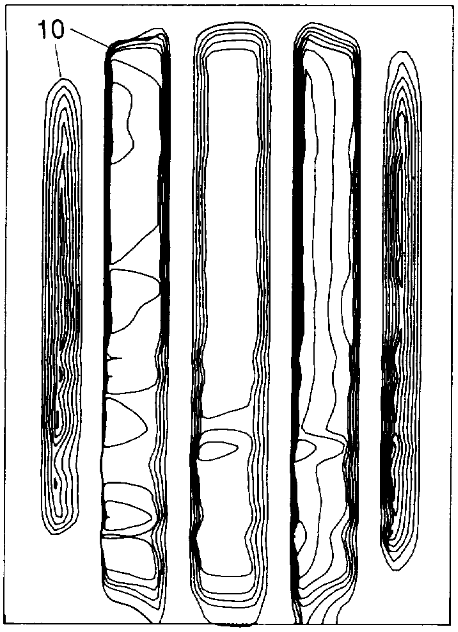
Drag forces
Contour interval = 4 lb



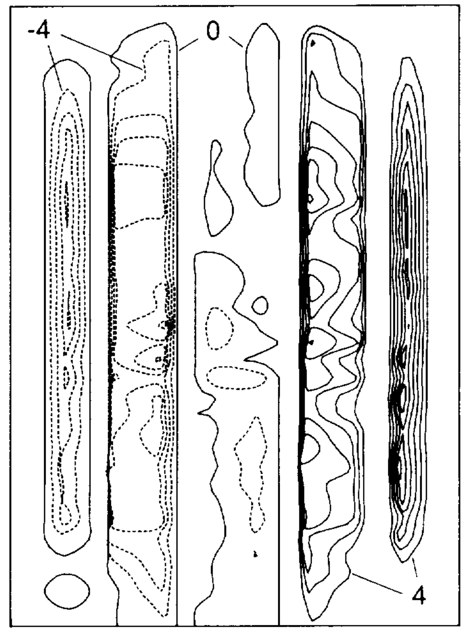
Tangential forces
|—| = 30 lb

(b) Vertical load of 16 000 lb.

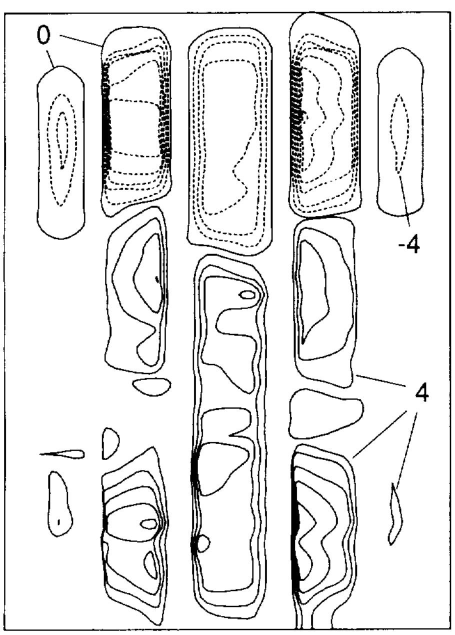
Figure 7. Continued.



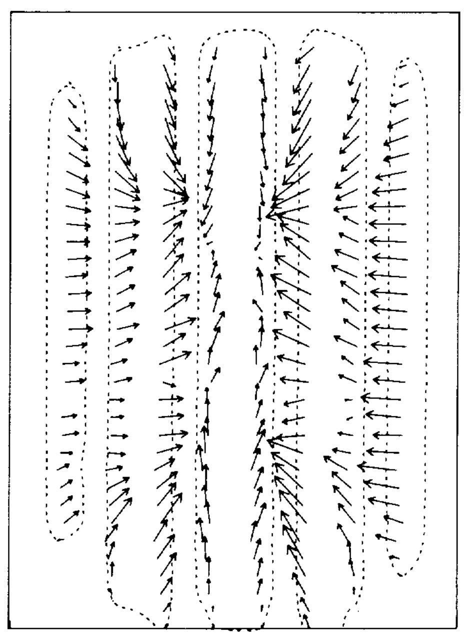
Vertical forces
Contour interval = 10 lb



Lateral forces
Contour interval = 4 lb



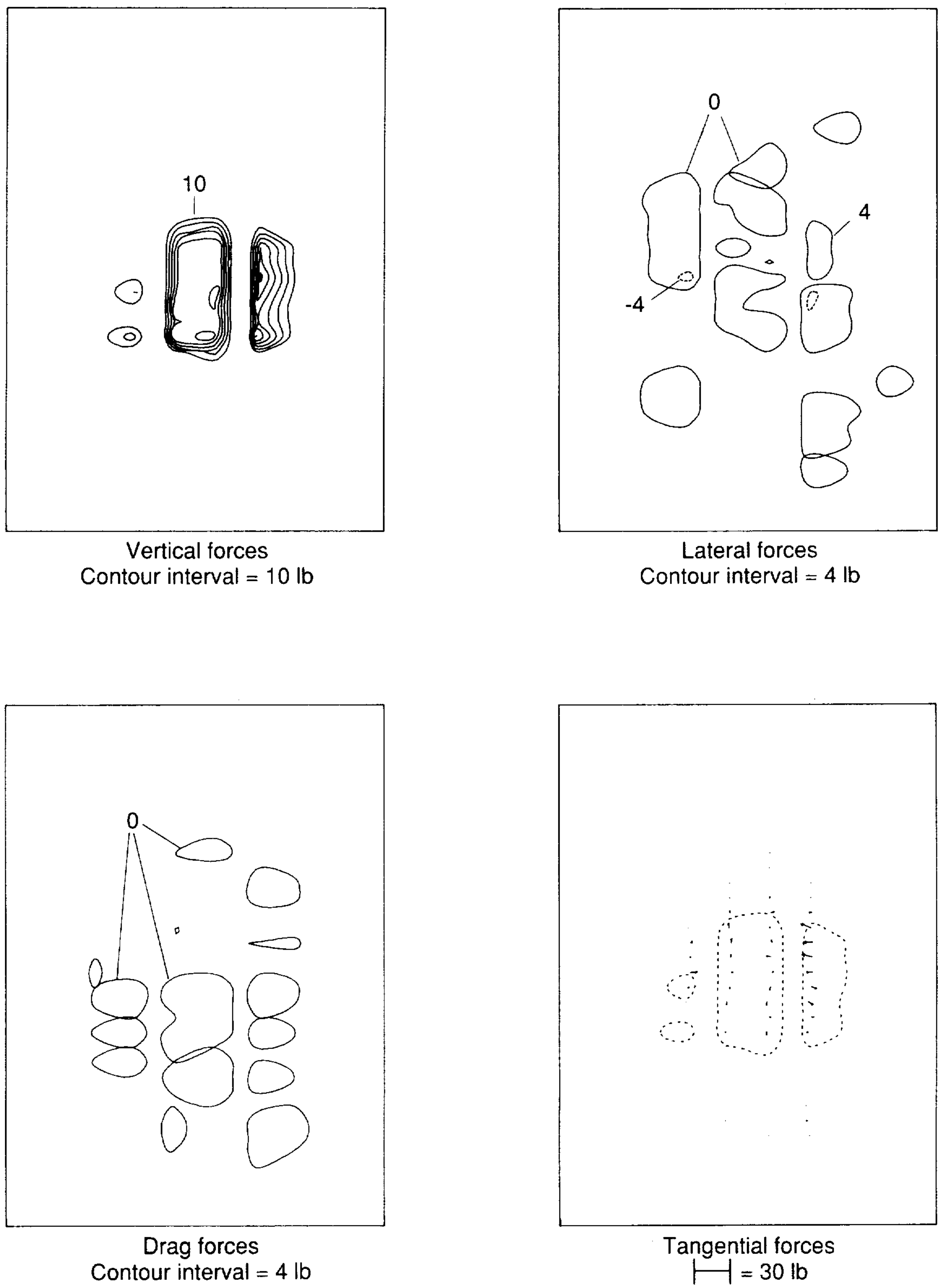
Drag forces
Contour interval = 4 lb



Tangential forces
= 30 lb

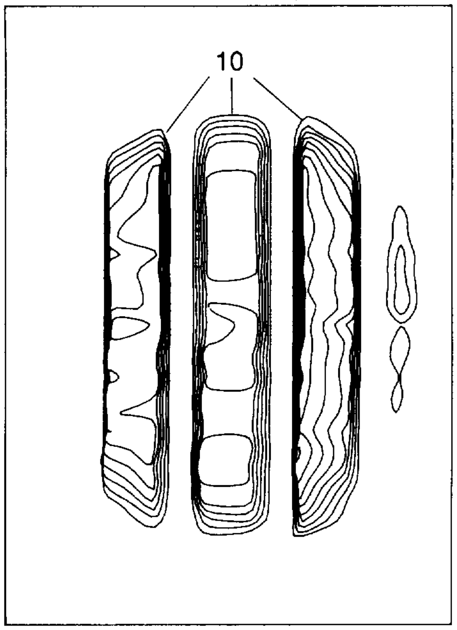
(c) Vertical load of 30 000 lb.

Figure 7. Concluded.

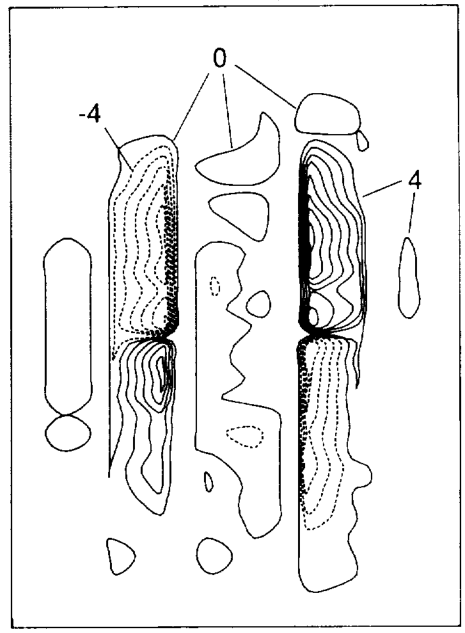


(a) Vertical load of 2000 lb.

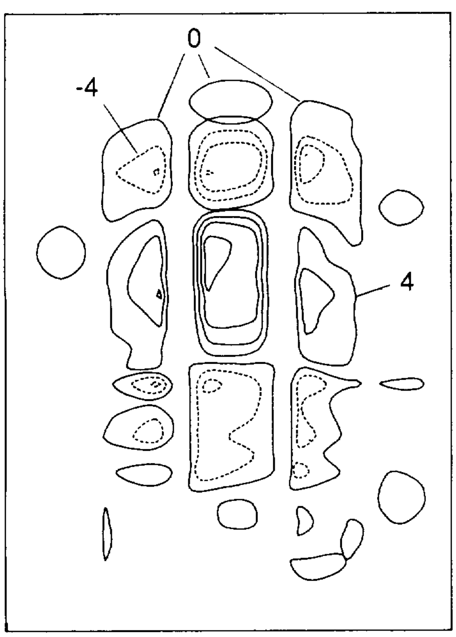
Figure 8. Footprint local force contours for 40 × 14 aircraft tire inflated to 170 psi.



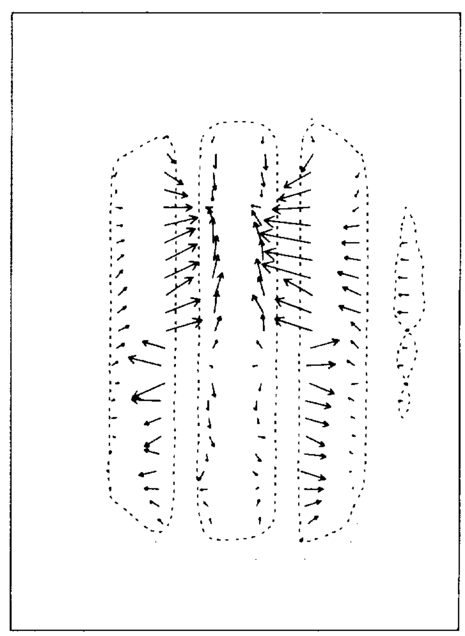
Vertical forces
Contour interval = 10 lb



Lateral forces
Contour interval = 4 lb



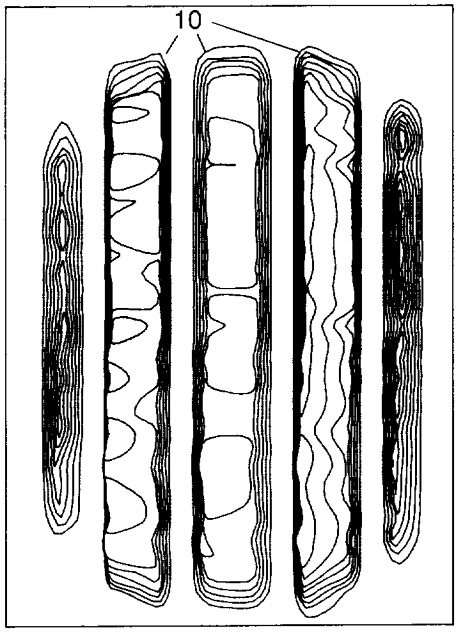
Drag forces
Contour interval = 4 lb



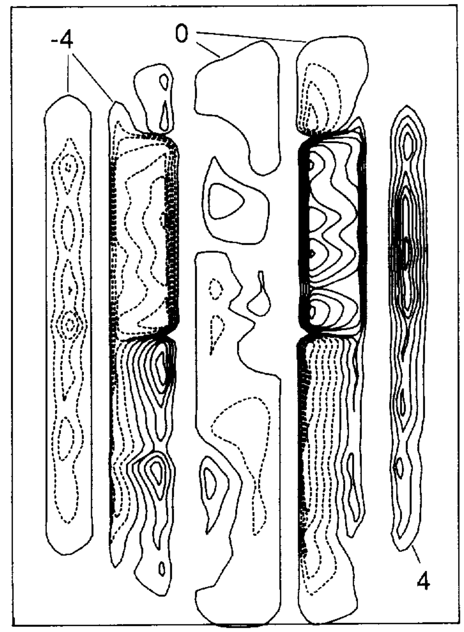
Tangential forces
= 30 lb

(b) Vertical load of 16 000 lb.

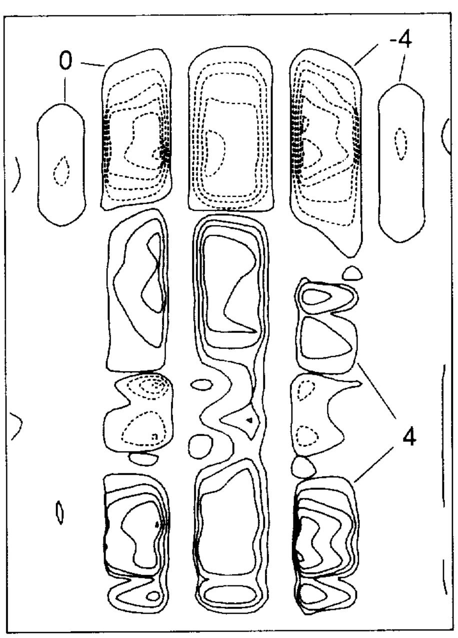
Figure 8. Continued.



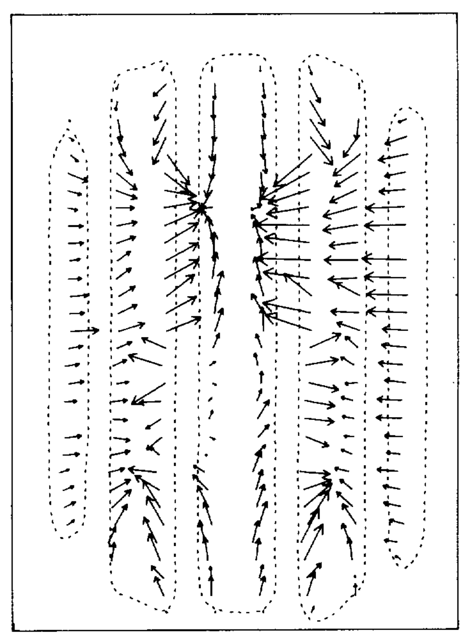
Vertical forces
Contour interval = 10 lb



Lateral forces
Contour interval = 4 lb



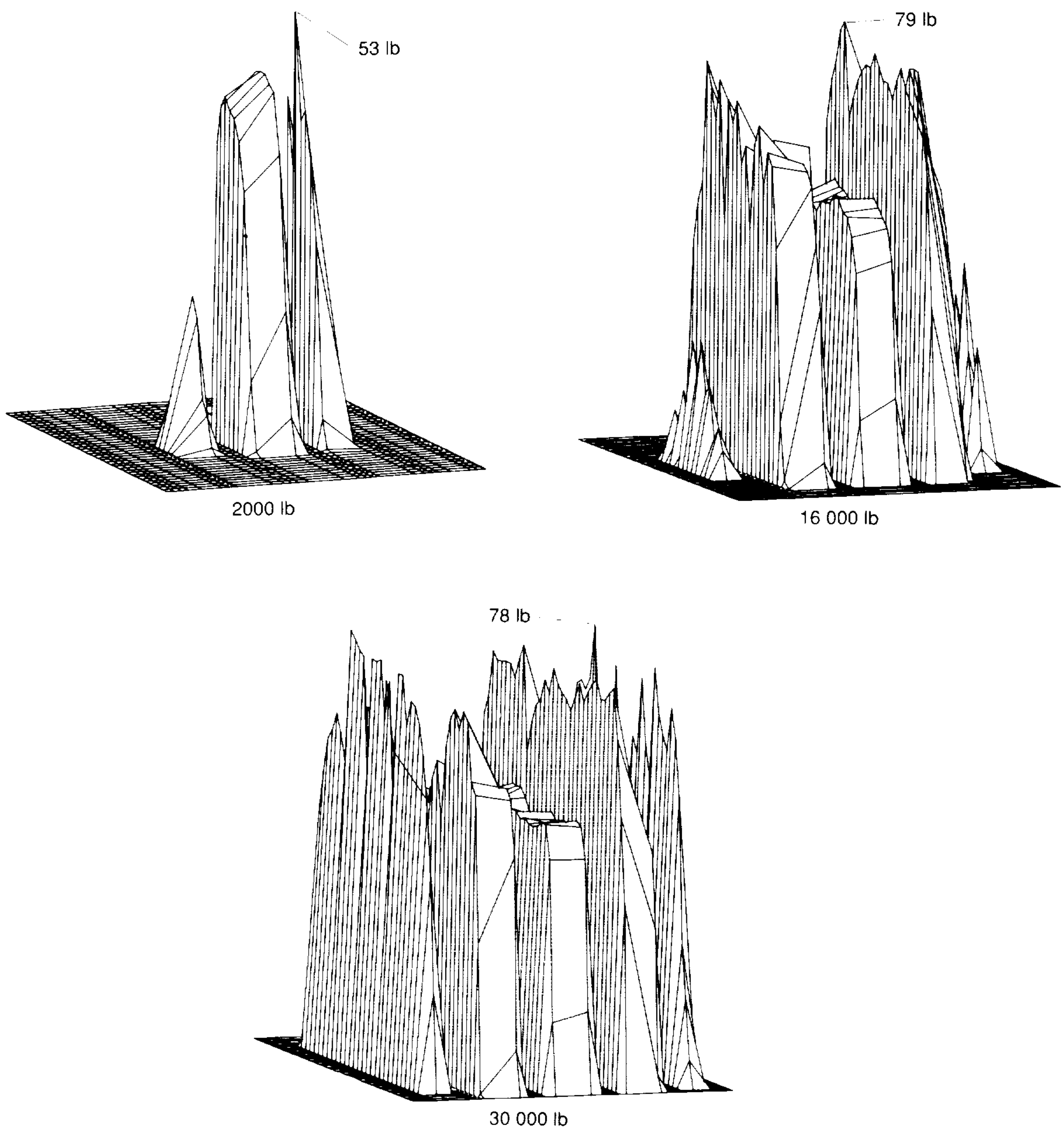
Drag forces
Contour interval = 4 lb



Tangential forces
|—| = 30 lb

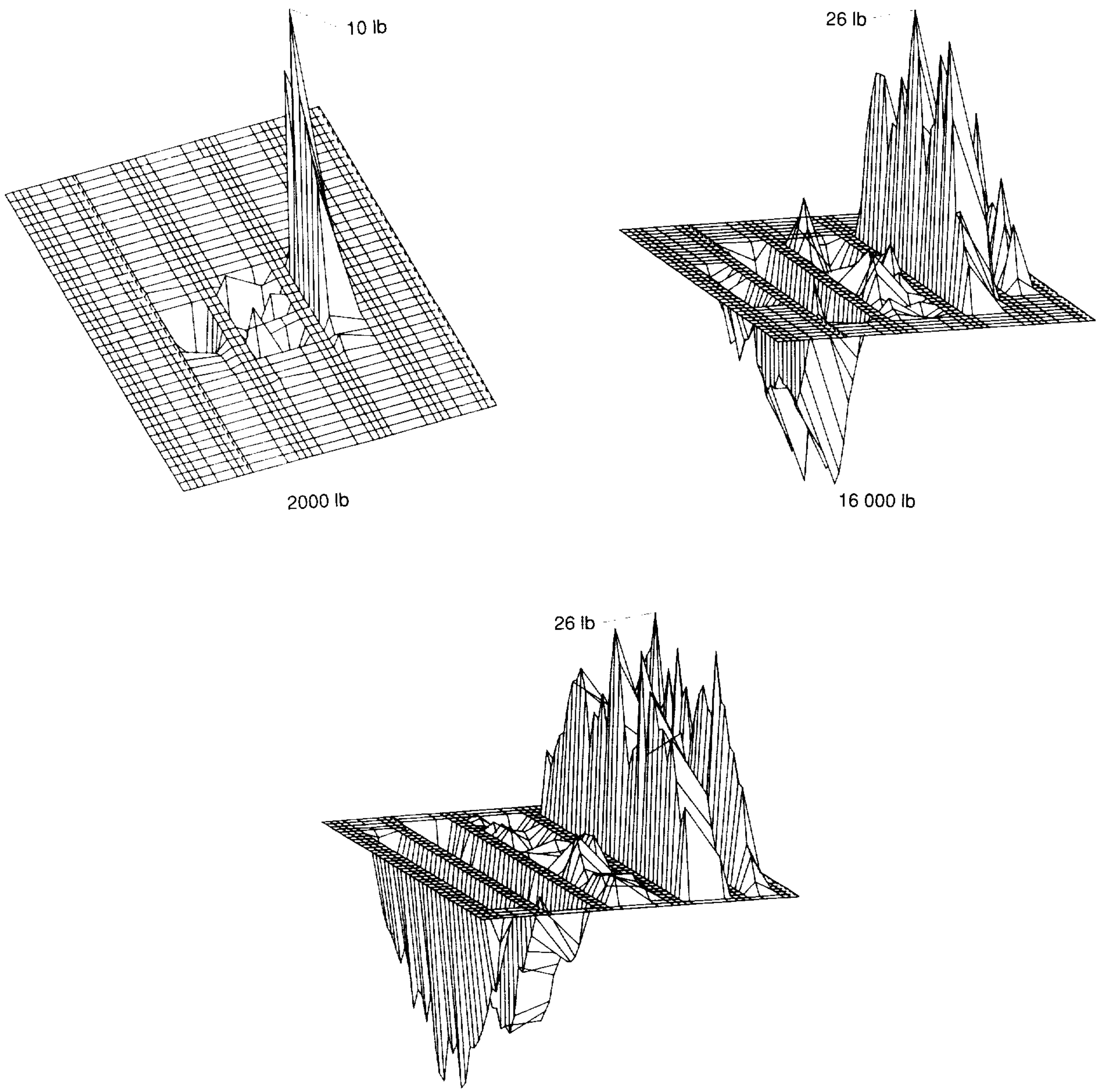
(c) Vertical load of 30 000 lb.

Figure 8. Concluded.



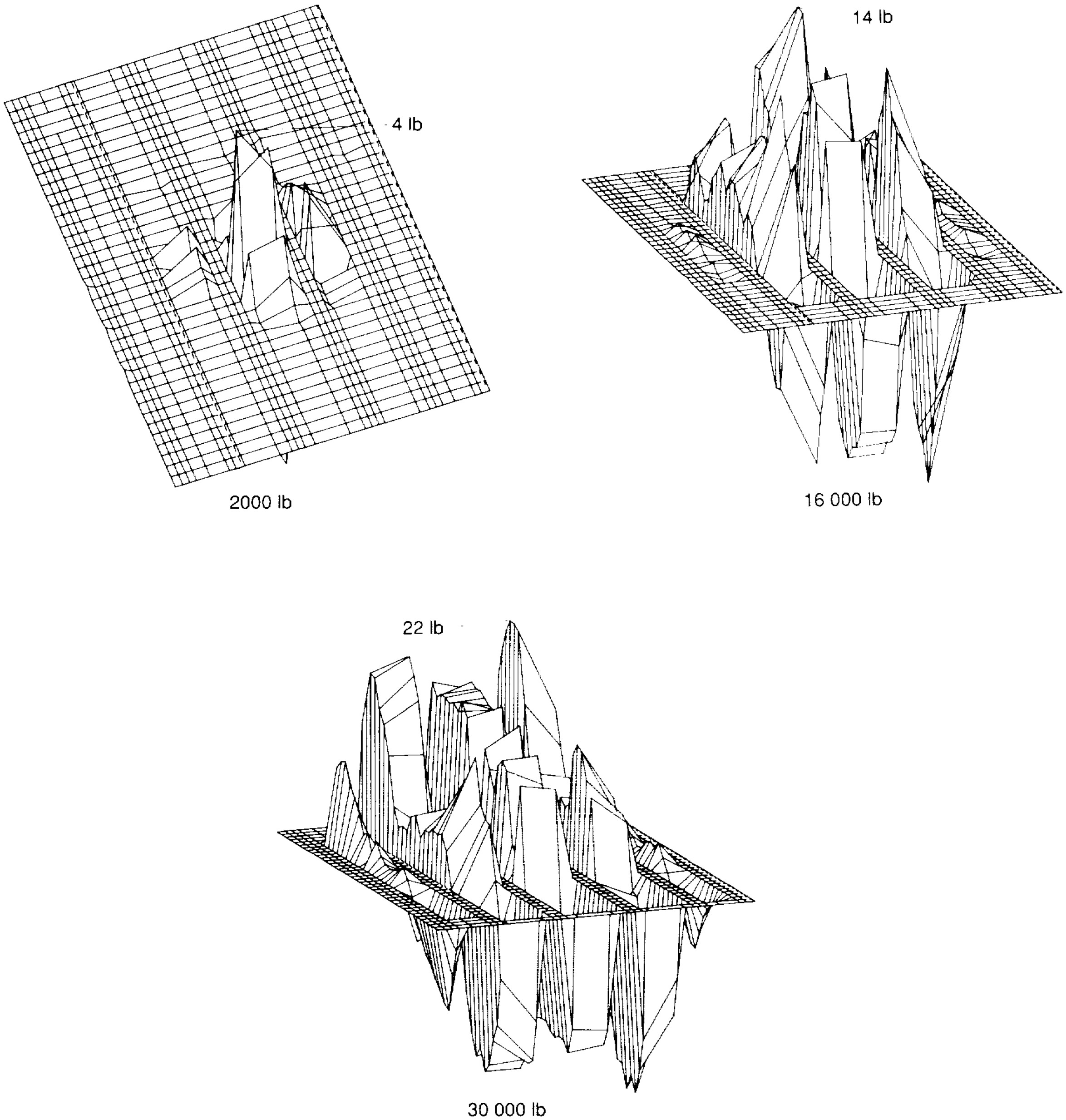
(a) Vertical forces.

Figure 9. Three-dimensional views of 40 × 14 aircraft tire footprint local forces for three vertical loads at an inflation pressure of 140 psi.



(b) Lateral forces.

Figure 9. Continued.



(c) Drag forces.

Figure 9. Concluded.

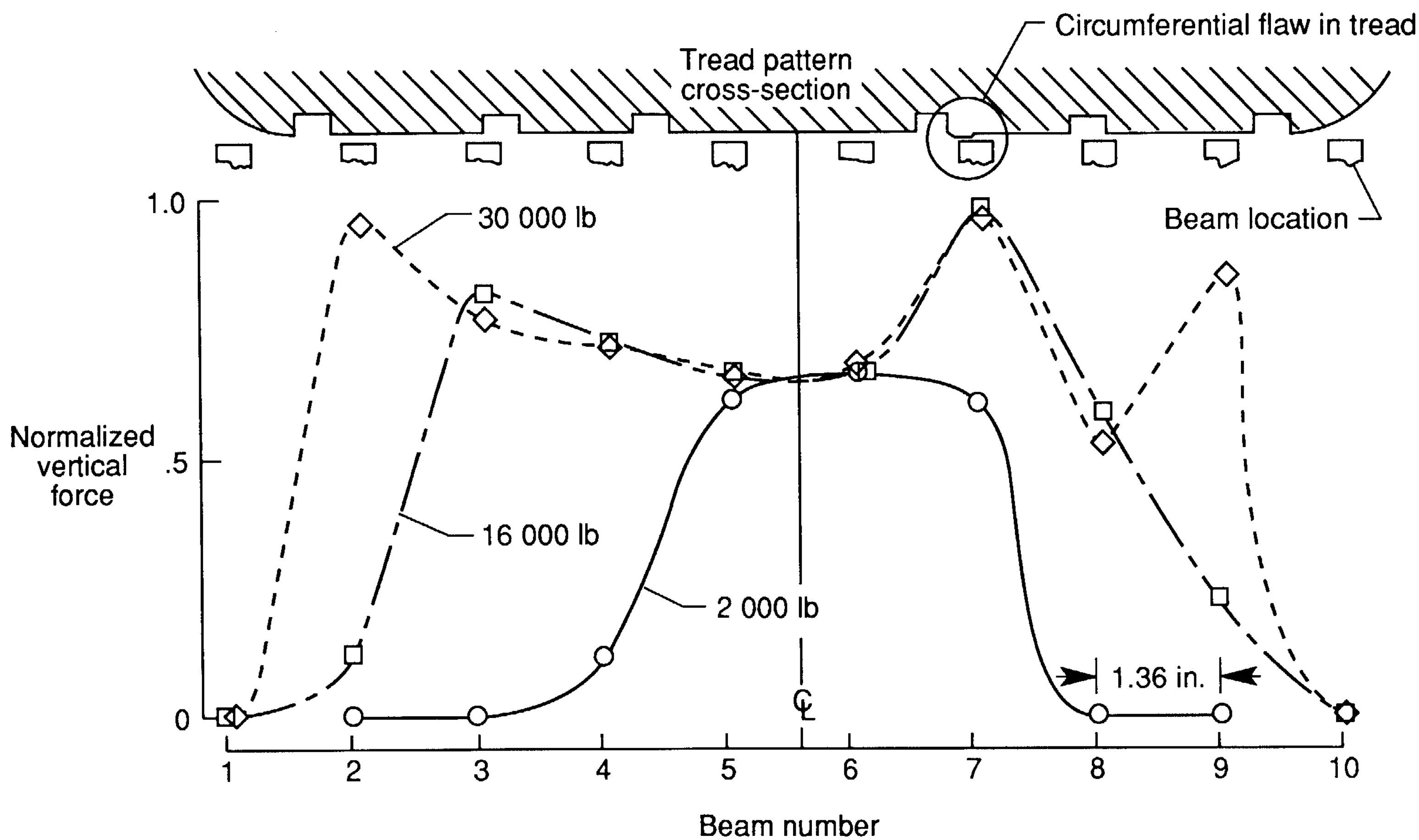
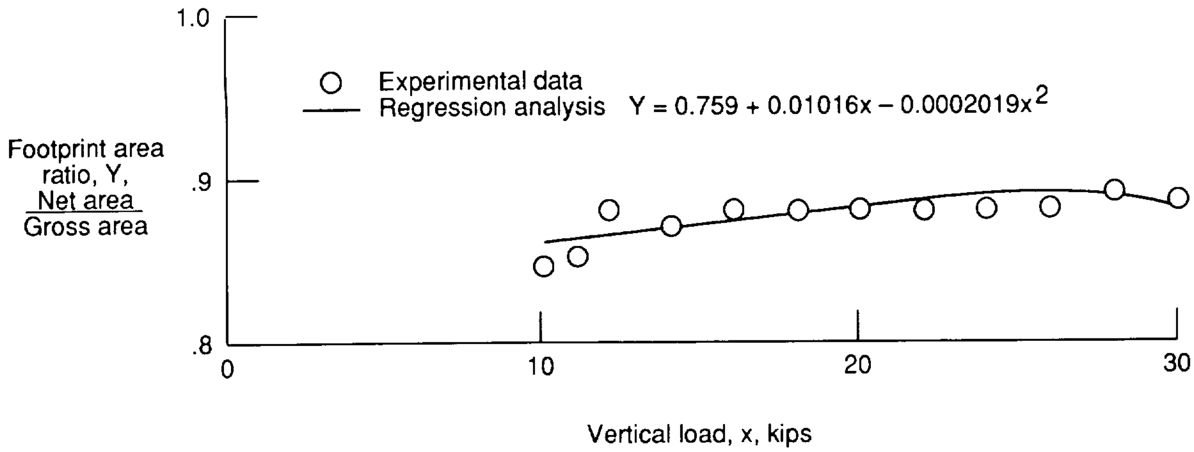
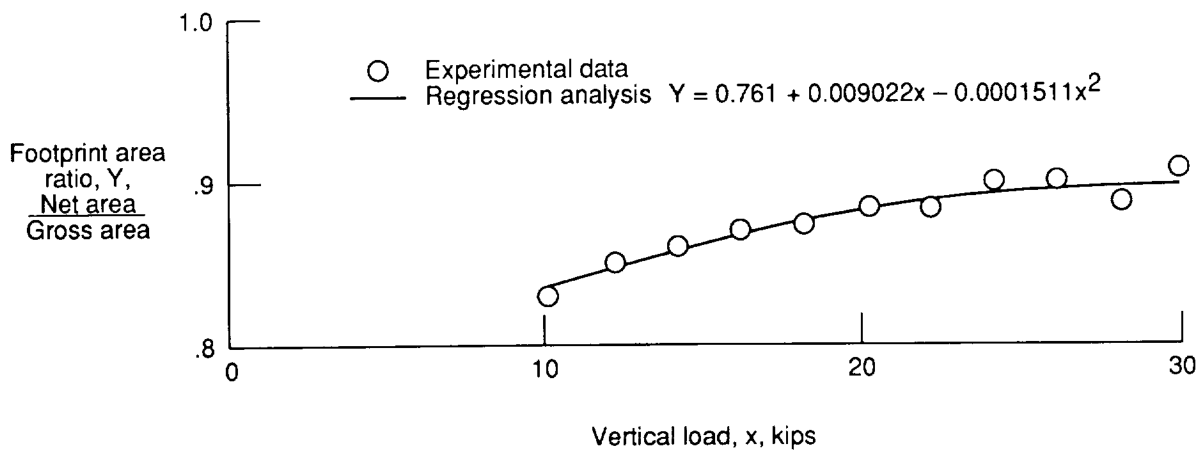


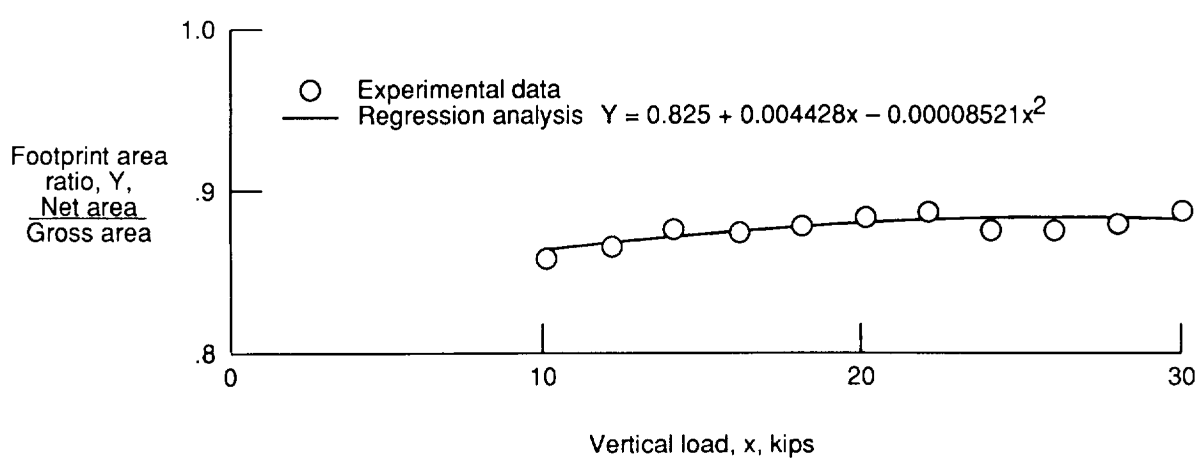
Figure 10. Vertical forces across the midpoint of the footprint tread ribs of 40 × 14 aircraft tire inflated to 155 psi.



(a) 140 psi.

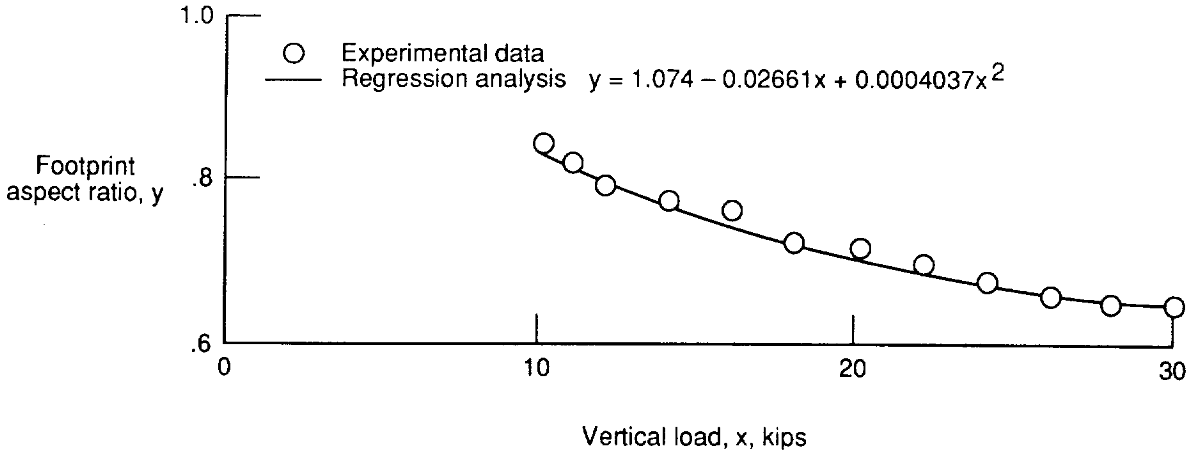


(b) 155 psi.

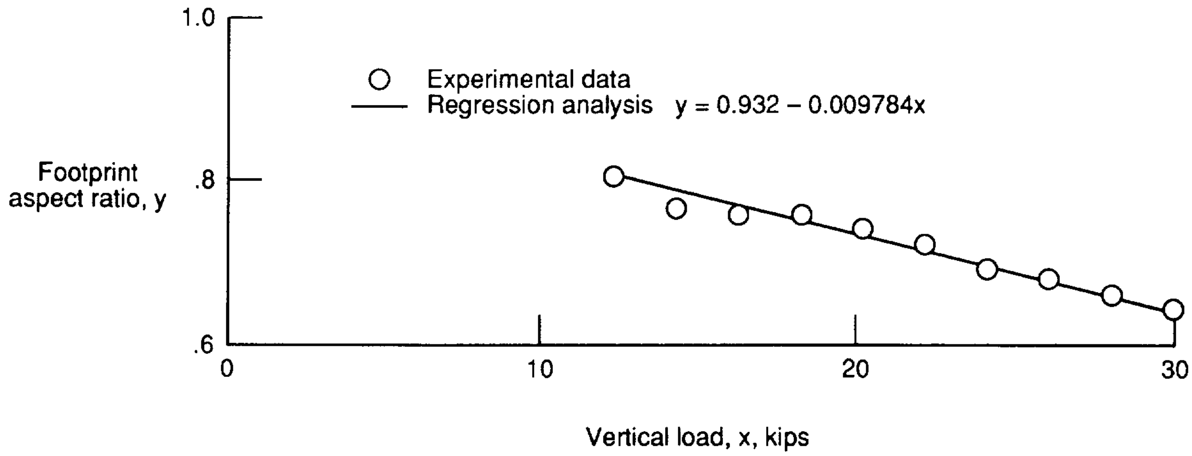


(c) 170 psi.

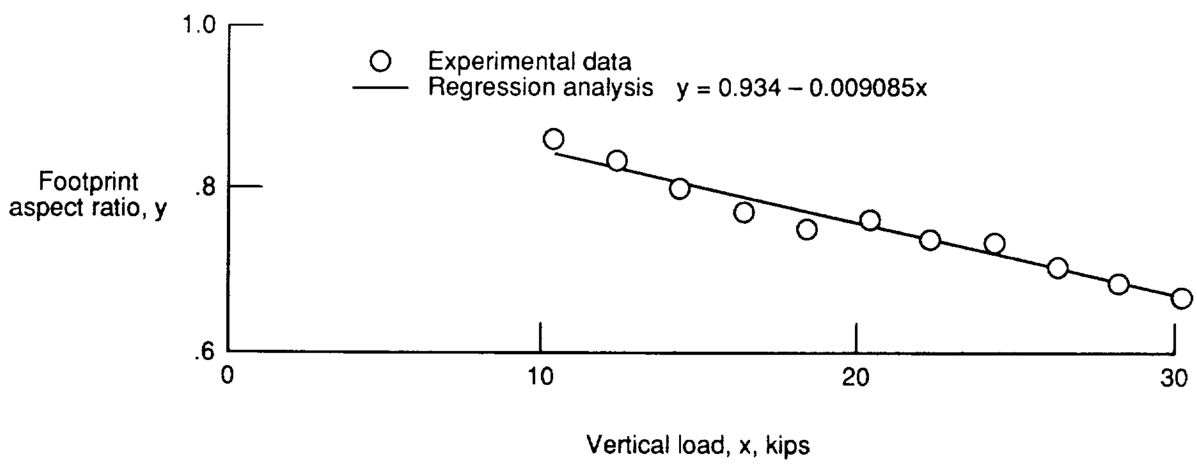
Figure 11. Footprint area ratio as a function of vertical load for 40 × 14 commercial airplane tire.



(a) 140 psi.

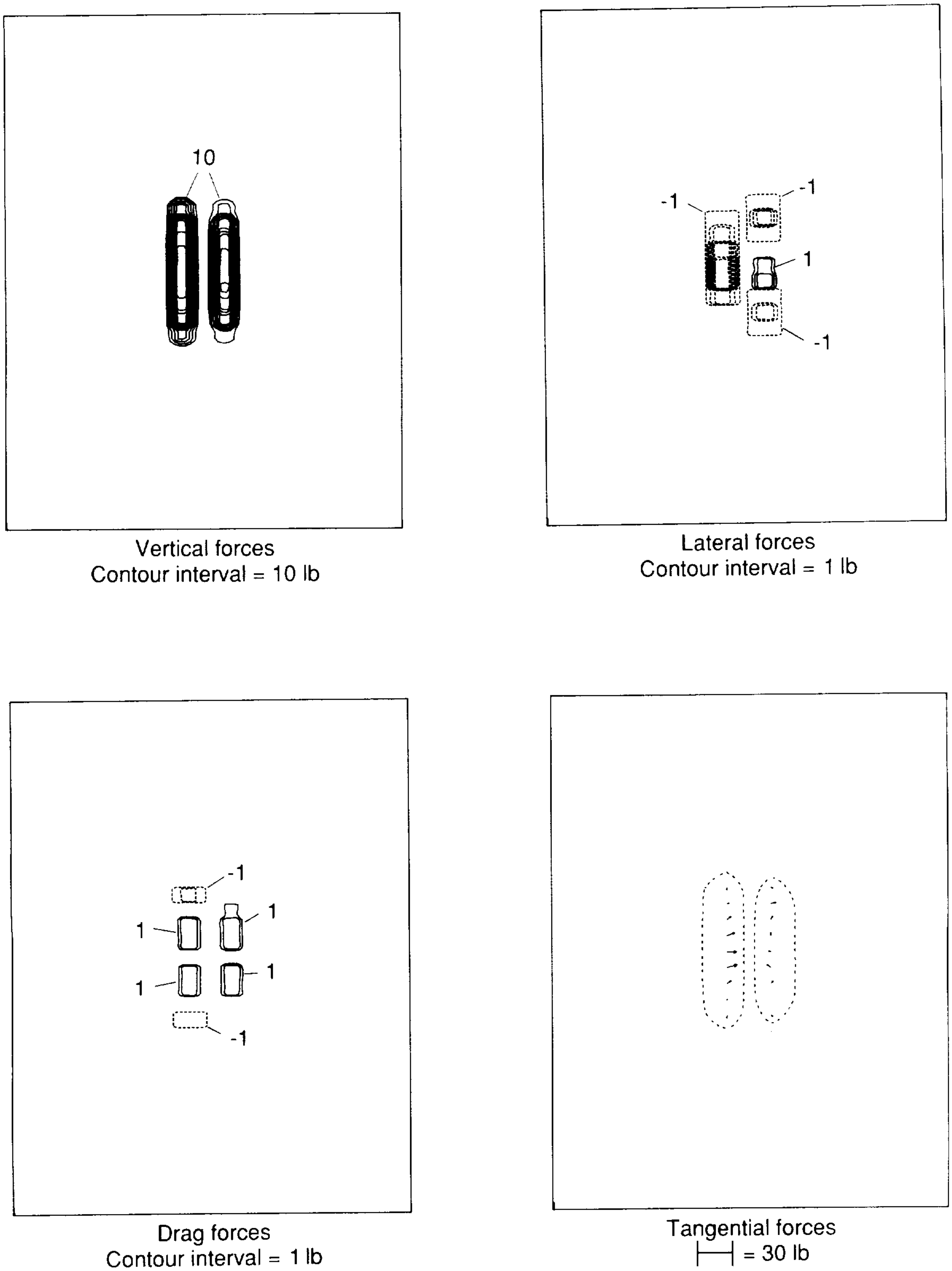


(b) 155 psi.



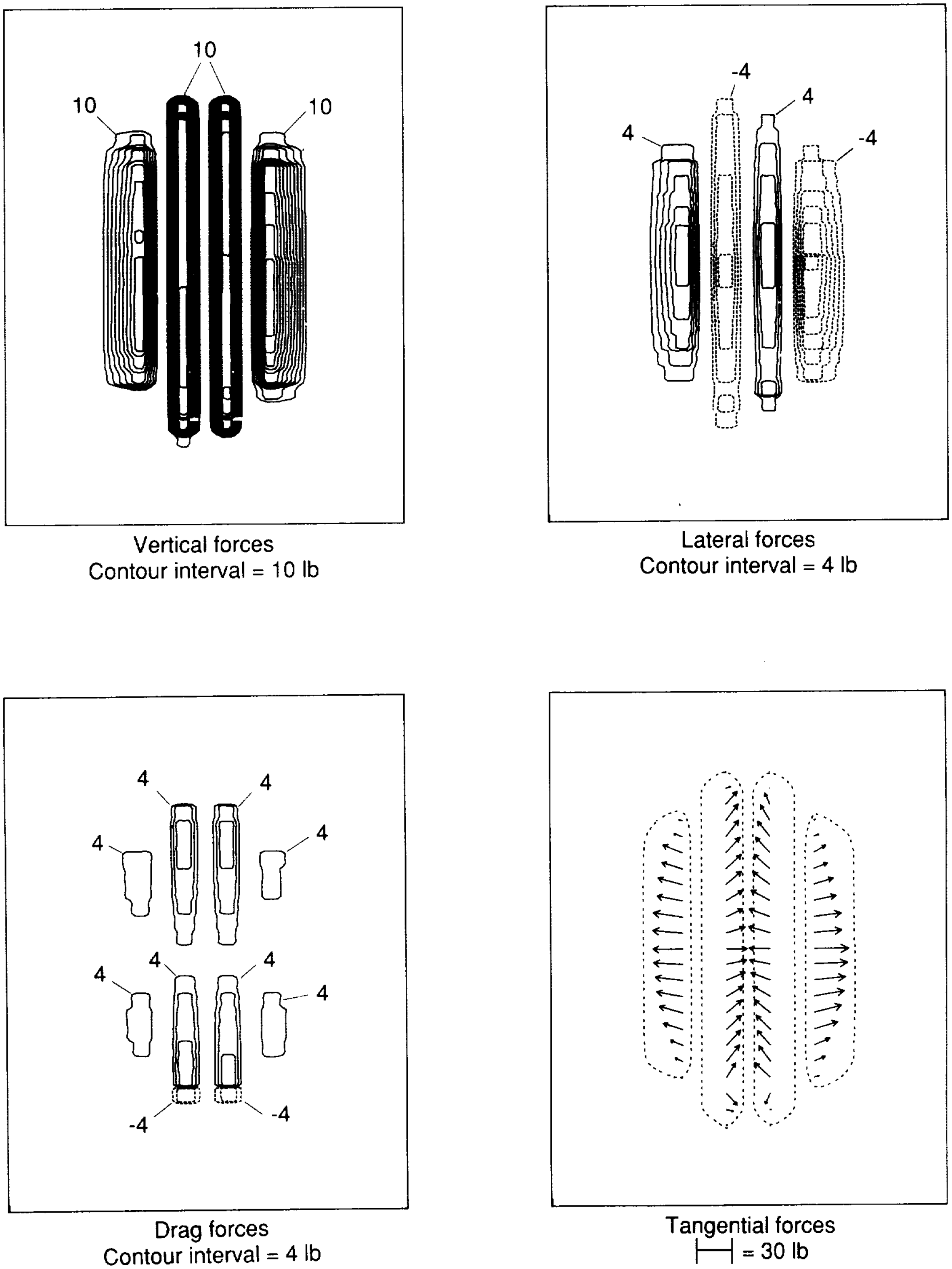
(c) 170 psi.

Figure 12. Footprint aspect ratio as a function of vertical load for 40 × 14 commercial airplane tire.



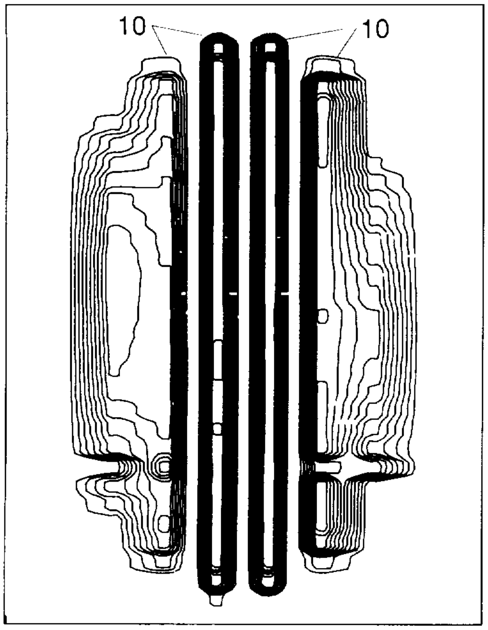
(a) Vertical load of 2000 lb.

Figure 13. Footprint local force contours for 32 × 8.8 Space Shuttle orbiter nose gear tire inflated to 300 psi.

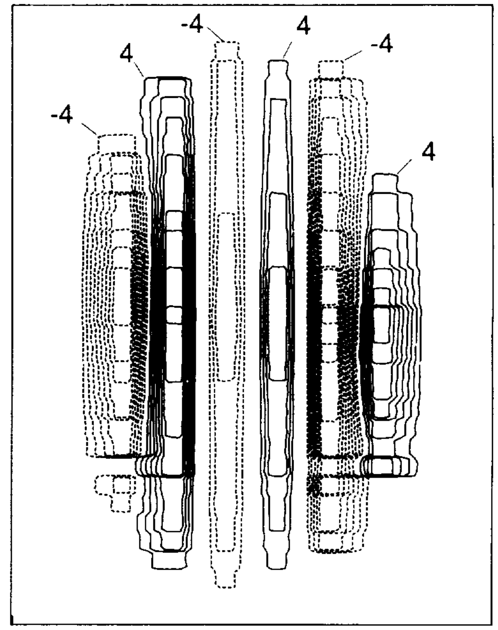


(b) Vertical load of 15 000 lb.

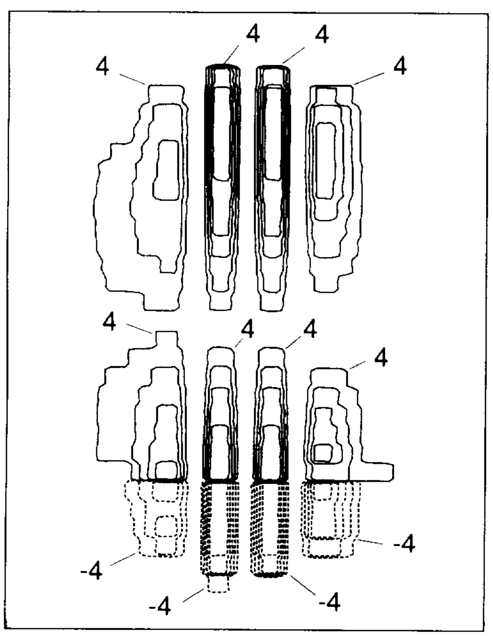
Figure 13. Continued.



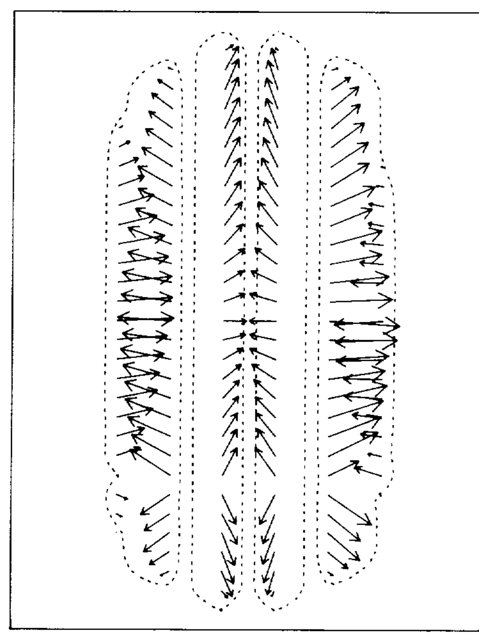
Vertical forces
Contour interval = 10 lb



Lateral forces
Contour interval = 4 lb



Drag forces
Contour interval = 4 lb



Tangential forces
⊢⊣ = 30 lb

(c) Vertical load of 30 000 lb.

Figure 13. Concluded.

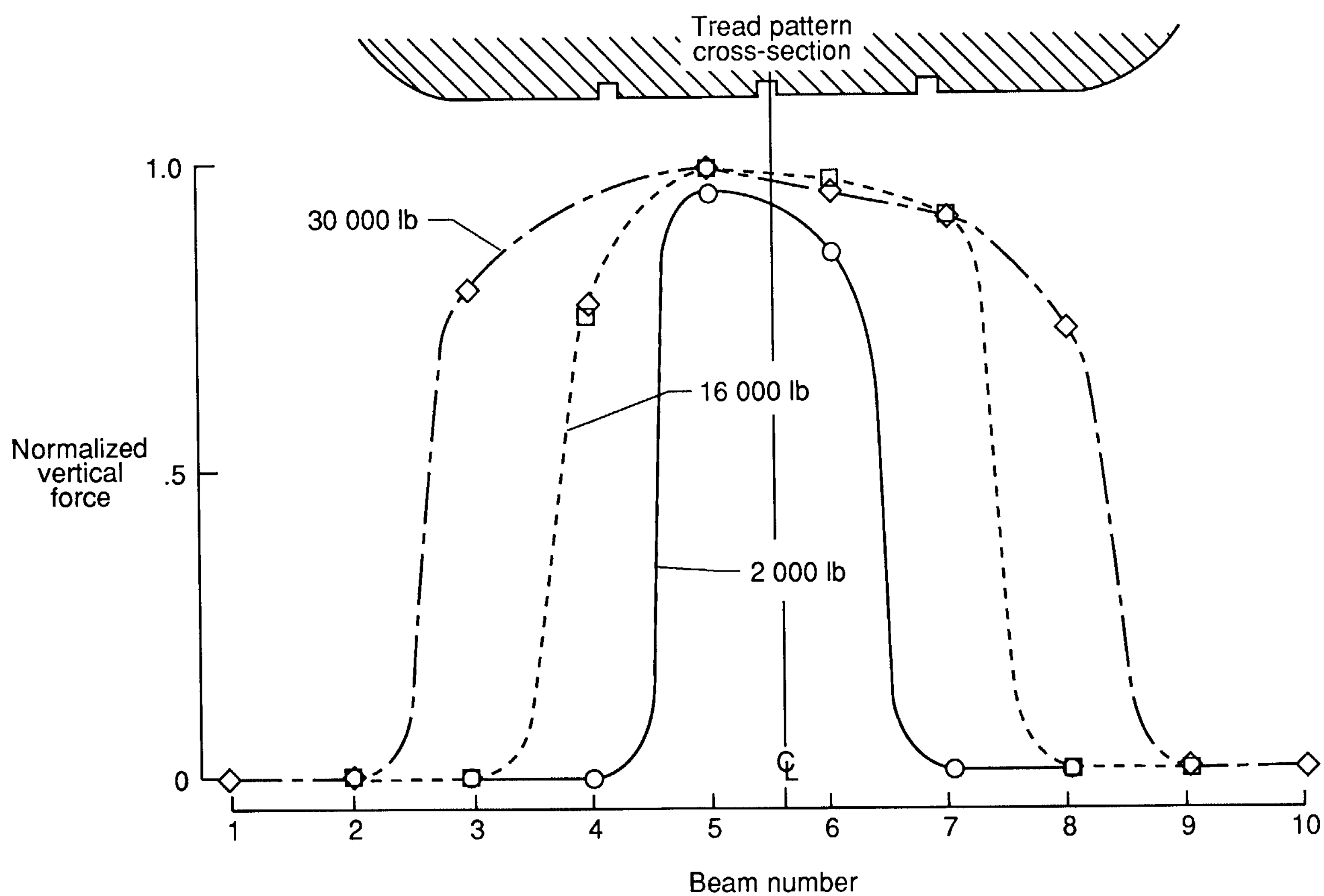


Figure 14. Vertical forces across the midpoint of the footprint tread ribs of 32×8.8 Space Shuttle orbiter nose gear tire inflated to 300 psi.

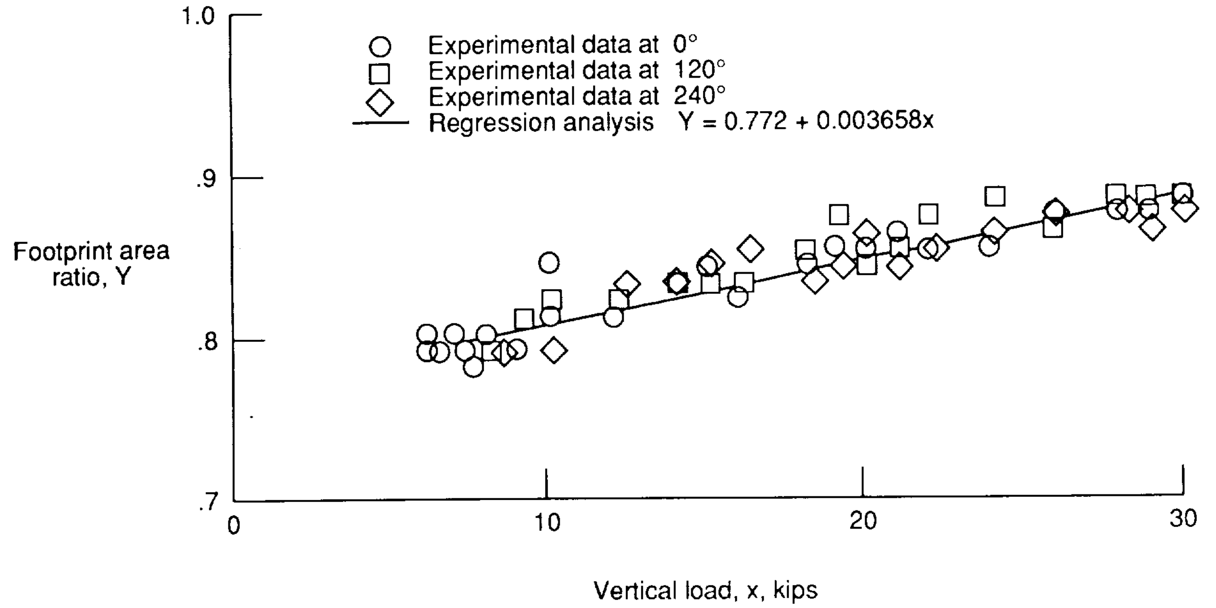


Figure 15. Footprint area ratio as a function of vertical load for 32 × 8.8 Space Shuttle orbiter nose gear tire inflated to 300 psi.

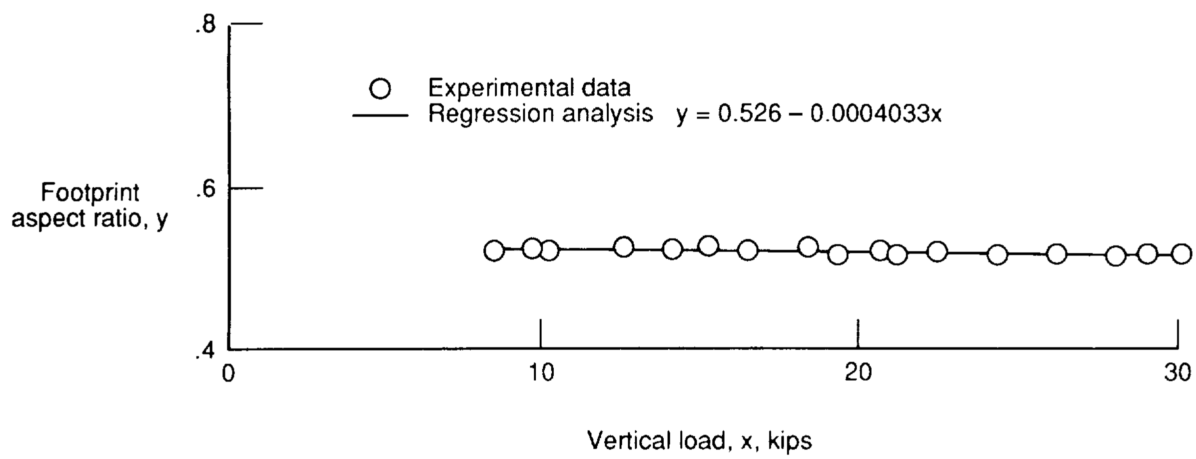


Figure 16. Footprint aspect ratio as a function of vertical load for 32 × 8.8 Space Shuttle orbiter nose gear tire inflated to 300 psi.

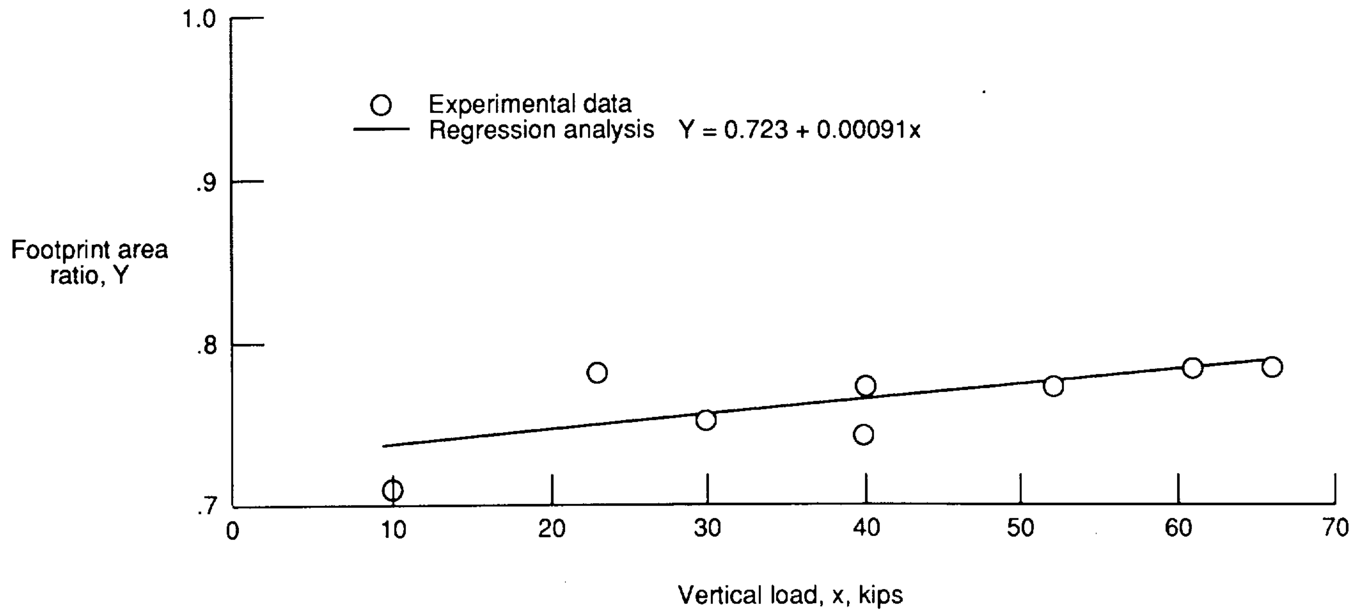


Figure 17. Footprint area ratio as a function of vertical load for 44.5 × 16 Space Shuttle orbiter main gear tire inflated to 315 psi.

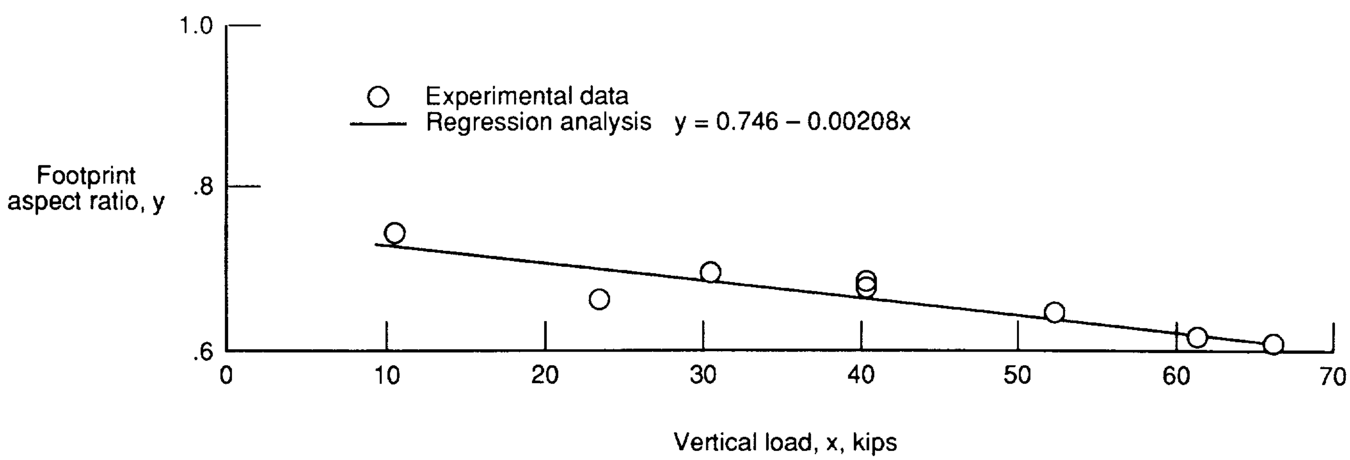


Figure 18. Footprint aspect ratio as a function of vertical load for 44.5 × 16 Space Shuttle orbiter main gear tire.

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15. Supplementary Notes

16. Abstract

The National Tire Modeling Program is a joint NASA-industry effort to improve the understanding of tire mechanics and develop accurate analytical design tools. This effort includes fundamental analytical and experimental research on the structural mechanics of tires. As an integral part of this program, footprint local forces, areas, and aspect ratios were measured. Local footprint forces in the vertical, lateral, and drag directions were measured with a special footprint force transducer. Measurements of the local forces in the footprint were obtained by positioning the transducer at specified locations within the footprint and externally loading the tires. Three tires were tested: (1) one representative of those used on the main landing gear of Boeing 737 and McDonnell Douglas DC-9 commercial transport airplanes, (2) a nose landing gear tire for the Space Shuttle orbiter, and (3) a main landing gear tire for the Space Shuttle orbiter. Data obtained for various inflation pressures and vertical loads are presented for two aircraft tires. The results are presented in graphical and tabulated forms.

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